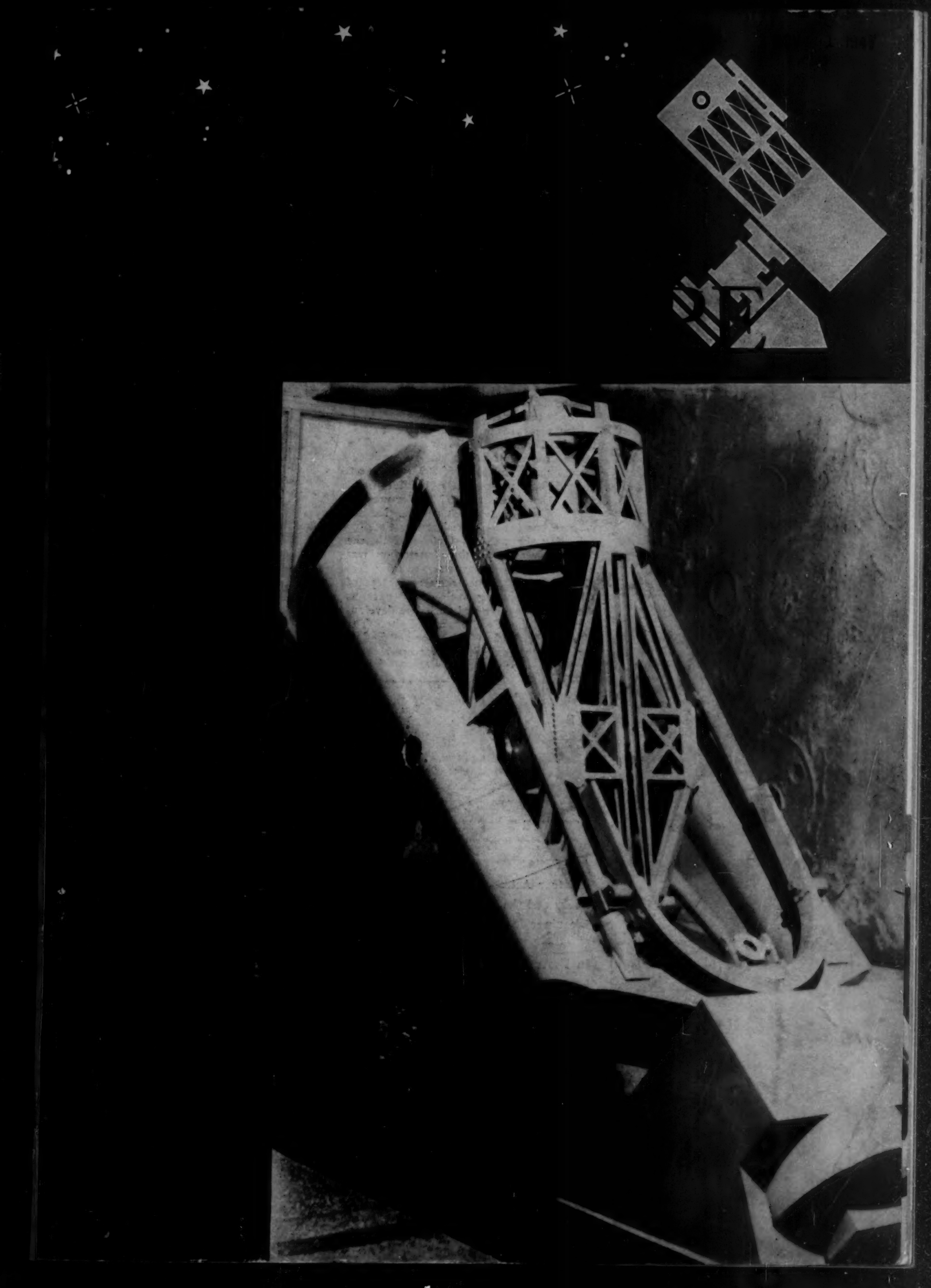

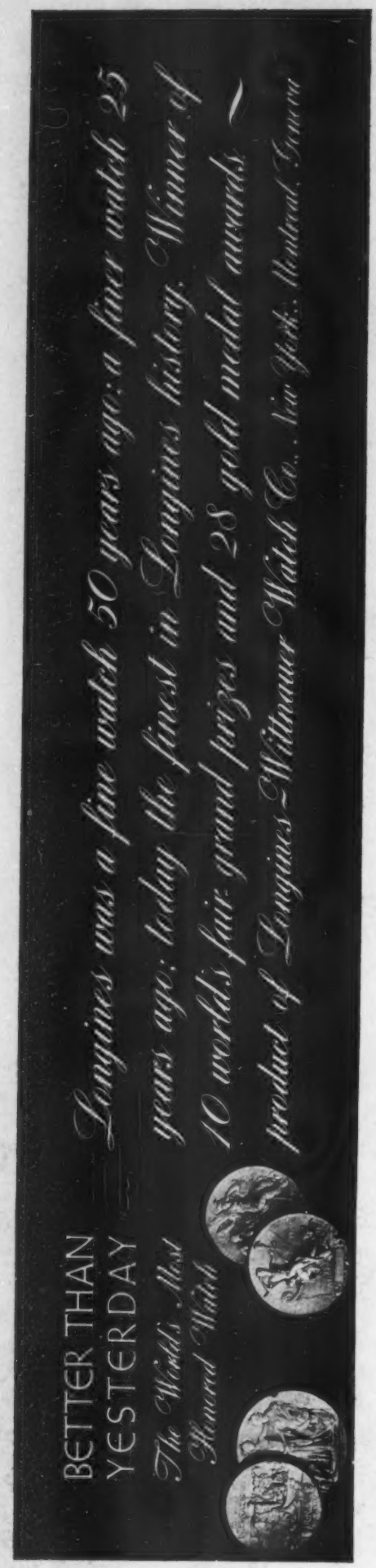
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PLANETARIUM ANNIVERSARY

TEN YEARS AGO, on November 2, 1937, the first American designed and built projection planetarium was opened to the public at the Museum of Natural History in Springfield, Mass. The projector of the Seymour Planetarium, pictured here, was designed and constructed by Frank D. Korkosz, technician of the museum. From a single sphere all the stars in the sky are optically projected.

The planetarium chamber is about 40 feet in diameter and 24 feet high. The seating capacity of 150 persons is satisfactory for Springfield's 160,000 population. Over 110,000 persons, school children and adults, have heard about 1,850 lectures by Mr. Korkosz in the past decade. No admission has been charged at any time.

During the week of October 24th, the 10th anniversary of the planetarium was celebrated. On display was an exhibit of photographs of planetarium projectors of all kinds, including such early types as the Atwood sphere and such late developments as the Peerless and Spitz. The STARS (Springfield Telescope and Reflector Society) exhibited telescopes made by the local amateurs.

The Korkosz projector of the Seymour Planetarium, Springfield Museum of Natural History.

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BACK COVER: Circumpolar star trails, photographed by Frederick K. Vreeland, Mill Valley, Calif., net exposure time 12 minutes. The camera had a 4-inch lens of the anastigmat type, 13½-inch focus. (See In Focus.)

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A Scale Model of the 200-inch Telescope

By Leo J. Scanlon, *Valley View Observatory*

WHEN PLANS for the 200-inch telescope were proposed nearly two decades ago, among others there was suggested a mounting in the form of a huge fork, similar to that of the 60-inch reflector at Mount Wilson. Pictures of the proposed mounting were published, and one of them in an early edition of *Men, Mirrors and Stars,* by G. Edward Pendray, aroused considerable interest in a restricted area of Pittsburgh, specifically, Millvale. Here the book with its fine illustration attracted the eye of Cliff E. Raible, an amateur astronomer and telescope maker of long standing and much sitting, particularly at the knife-edge test stand.

In 1914, he completed a 6-inch mirror and submitted it for test to J. B. McDowell, John Brashear's son-in-law, at that time head of the world-renowned telescope making establishment. This authority approved Raible's first mirror, and encouraged further efforts which produced in succession another 6-inch and two 12-inch reflectors — the latter mirrors were ground on each other's backs! Thus satisfied for a while, Cliff devoted his time to enjoying his telescopes, doing a bit of painting in oils, and mastering the obscure techniques of pattern making, molding, and casting in sand.

Perhaps it was this background of experience which gave him the confidence to attempt building a scale model of the proposed telescope, with no other guide than a photograph of a model. This first model telescope was completed by Raible in less than a year, from start to finish. It was built to a scale of 1/25 actual size, thus having an 8-inch mirror for its primary. The tube, fork, and base were made of aluminum, molded and cast by Raible, using his home-heating furnace with a forced draft to melt the metals. Hundreds of hours of spare time were required to complete this model, which amateurs who attended the convention in Pittsburgh in 1940 may recall seeing.

But then the powers-that-be decided against the fork mount for the 200-inch instrument; they adopted the now familiar yoke with a horseshoe journal as the north bearing. Since Cliff Raible had decided to build a model of the 200-inch, and since the one he had completed would not be authentic, there was no alternative but to start another model.

This time there was more information available. Through the courtesy of influential friends, Cliff was able to follow minutely the construction plans of the big mounting, and early in 1939 decided to build an accurate 1/16 scale model. Materials began to accumulate in the tiny workshop in Millvale. One look at the working space might have discouraged a fainter heart, for the rug-sized shop was already crowded efficiently with an 11-inch screw-cutting lathe, a ½-inch drill press, numerous patterns, copes, drags, and bushels of molding sand. In one corner was a huge stack of aluminum, in anticipation of the many nights of melting and pouring to come.

While the north bearing for the big telescope was being fabricated and machined at the Westinghouse East Pittsburgh works, the amateur astronomer was a frequent visitor, spending many hours watching the operation and talking with the workers. This familiarity with the construction of the original paid dividends when the model horseshoe journal bearing and its mating pads were made later. This was probably the most difficult part of the model to construct. The outside diameter of the horseshoe is 34 inches, its face 3 3/16 inches high. Fabricated of steel sheets welded together to form (at first) a complete circular bearing, its 160 pounds made it difficult to handle alone, and Mrs. Raible was called upon frequently to assist in moving it.

Some time was spent locating a large boring mill sufficiently accurate to machine the outside of the journal bearing, and at last a brand new 45-inch mill was located. Arrangements were made to permit Raible to surface his bearing on it for the machine's maiden effort, and the fine condition of all its parts enabled a very accurate journal to be completed. After the throat of the horseshoe was cut out of the machined perimeter, the strain released was so slight as to alter the dimensions of the bearing by less than 0.002 inch, thanks to a fine annealing after fabrication.

All patterns for the instrument were constructed as required or anticipated, and all castings were poured by Raible unassisted. The only stock parts used in the model were nuts and bolts, and some motors.

World War II caused a 3½-year recess from the work, this time being devoted to special service for the Navy, taking the amateur astronomer the length and breadth of the country. However, much valuable training was acquired which helped materially in later work on the model.

The telescope model was exhibited in the Buhl Planetarium at the October 12th meeting of the Amateur Astronomers Association of Pittsburgh. It contains a 12½-inch pyrex mirror, 22½ inches focal length, with a 4-inch pyrex secondary, and auxiliary flats to enable the secondary focus to be formed at the lower end of the south polar bearing. Also, a secondary focus can be formed at either extremity of the declination-axis tubes, where eyepiece sockets are arranged. Photographs can be secured at the prime focus by removing the Cassegrainian secondary mirror and inserting a plateholder in the prime-focus cage, but in this model the astronomer must stay outside to do the guiding.

The tube, when directed to the zenith, stands nearly six feet from the floor to the top. It is built entirely of cast aluminum structural members, and weighs approximately 95 pounds. It is supported by the yoke (horseshoe) at the north end, two stainless steel welded tubes along the sides, and another fabricated yoke at the south end.

The north pier is the most massive single member, weighing well over 300 pounds due to its all-steel construction. It carries at its top the girder which supports the four oil-bearing pads upon which the journal bearing rests. The south polar bearing consists of a 6-inch bronze hemisphere supported by three oil-fed pads similar to those at the north end.

The telescope is driven in right ascension by a 1 r.p.m. synchronous motor, through 60- and 24-tooth worm wheels.

A view of the Raible 1/16 scale model, showing the north pier and the horseshoe bearing. The human figure in the lower right is also reduced to scale! The front cover view is from the south. Photograph by William Fielding and Edward Studeny.

The first design of the 200-inch project was the basis for this 1/25 scale model made by Mr. Raible. It was exhibited at the Second National Convention of Amateur Astronomers in Pittsburgh, in 1940. Photo by Stephen S. Nagy.

The 60-tooth worm does the driving and floats on the polar-axis shaft (which is really a hollow tube). Driving contact is established by a switch which energizes a magnetic clutch, fastened to the south polar axis. This causes the clutch to adhere magnetically to the rotating steel worm wheel, carrying the telescope along with it. This clutch is quite interesting, and required considerable research before it could be constructed. It consists essentially of four coils in a unit attached to the polar-axis tube. Each coil is built of sheet-iron laminations, individually insulated with paper and shellacked to insure molecular flow in one direction.

The clutch is energized by batteries, the switch being so arranged that when the clutch is disengaged, the direct-current lag is removed by demagnetizing the cores and the steel right ascension drive worm by instantaneous application of eight volts of alternating current supplied by a transformer.

For fast motion in right ascension, there is another floating gear on the same south polar axis, with another magnetic clutch to engage it. This "slewing" gear is driven by a reversible motor, controlled by a four-way switch on an independent control panel, where all controls and setting circles are mounted. Another reversible motor operates the drive in declination. Attached to the telescope itself are two Selsyn motors, synchronized with their mates on the control panel. Through them the position of the telescope is indicated by right ascension and declination dials.

As in the large telescope, the oil-flotation system was used for the main bearings, and proved interesting to accomplish. There are four pads at the north bearing, three at the south. Oil is supplied to the face of each pad through four tubes imbedded in its babbitt face; these tubes lead to a recess in the pad which is kept supplied with oil under sufficient pressure to raise the entire mounting about 0.0015 inch from the pads.

The oil is fed by 3/16-inch tubing which leads from a tank kept under air pressure supplied by a compressor operating at 75 pounds. This compressed air passes through a sensitive reducing valve by means of which the pressure of the oil is regulated to keep the mounting floating without having the oil gush out of the pads. There is a slight seepage here, and this waste oil is drained through leaders to a storage tank for future use. In all, 10 brands and viscosities of oil were tried before a satisfactory one was found. During one of the test runs, Mrs. Raible was invited to watch. Perhaps it was the tension of the moment which caused Cliff's hand to open the pressure too suddenly — causing a fan of oil to leap from between the pads and journal bearing, definitely ruining one dress. After that sad experience, no amount of cajoling could induce Mary Raible to watch the oil tests, but that did not prevent her giving willing assistance when heavy parts were ready to be mounted or assembled.

Mary's most valuable contribution to the successful completion of this fine working model was not helping test the oils, but was of a more passive nature. Saturdays and Sundays Cliff spent almost entirely in the cellar, often working from breakfast to midnight, quitting only at his wife's insistence. Keeping warm in winter was not much of a problem when castings were being poured. Frequently the forced draft on the hot-air furnace necessitated opening the windows to prevent suffocation, and the neighbors then wondered why Mary sat fanning herself on a chilly day. If they could have looked into the basement and seen Cliff ladling out the molten aluminum or bronze from the white-hot furnace, they might have understood that in making such a telescope, you need not only complete plans and large quantities of materials, but endless patience, skills, resourcefulness, ingenuity, and most of all an understanding wife!

Mirror for Mount Palomar May Be Moved in November

ACCORDING to press reports, the "most daring optical job ever attempted by man — the polishing of the giant 200-inch telescope mirror" was completed on October 3rd. It was announced at two o'clock that afternoon that tests made earlier in the week showed the mirror's figure to be perfect to within 1/10 of a wave length of light. Dr. John A. Anderson has directed grinding and polishing of the 200-inch mirror since the work began 11½ years ago, on April 22, 1936.

Dr. Max Mason, chairman of the Mount Palomar Observatory council, is quoted as saying, "Never before has so large a piece of glass been polished to such accuracy. Caltech astronomers have literally been 'sweating out' the past few months as the surface of the huge disk approached the perfection they sought. ... The closer they approached their goal the slower the work became, for it progressively called for more and more testing and less and less polishing. A mistake could have set back completion of the mirror for months."

Over five tons of glass were removed in deepening the mirror's center about 3¾ inches. Thirty-one tons of material were utilized in the grinding-polishing job, and some 180,000 man-hours.

At least a month more was to be required to prepare the mirror for transfer to the observatory atop Palomar Mountain in San Diego county, 130 miles southeast of Pasadena. The mirror will be mounted in the cell in which it is to be placed in the telescope, and then it will be packed in a huge insulated wooden box. The mirror, cell, and box together weigh about 37 tons, and will move by truck and 16-wheel trailer over a route especially designated by state and county highway departments, with a highway patrol escort for the entire trip. Road blocks will be set up where necessary. The Mount Palomar road has been resurfaced for the occasion.

The mirror will be aluminized at the observatory in a specially designed aluminizing tank. It is expected that mounting of the mirror in the telescope and testing of the entire instrument will be a matter of several months, so that a regular program of observations cannot be started before late in the spring of 1948 or early in the summer.

The September issue of the **Griffith Observer,** published by the Griffith Observatory in Los Angeles, is devoted to the 200-inch telescope. There are a brief article by Dr. Mason, two of the best Porter drawings, an aerial view of Mount Palomar, and other pictures and notes of interest concerning the world's largest telescope. There is also a picture of a 1/24 scale replica of the instrument and dome built by Samuel Orkin at a cost of nearly $25,000. This working model is now on exhibit in the Hall of Science of the Griffith Observatory.

The dome of the model is six feet in diameter and made of spun aluminum. Only one half of it has been made, in order that a full view of the model telescope may be obtained. Small dolls represent people in the building. Lighting in the background changes to show the stars.

NEWS NOTES

By Dorrit Hoffleit

MORE ON ARTIFICIAL METEORS

In the White Sands firing of a V-2 rocket on December 17th, the apparatus which was to have fired artificial meteors from shaped charges failed to work properly. That experiment will be repeated some time in the future; meanwhile, more ambitious plans are in prospect, as explained in *Ordnance,* journal of the Army Ordnance Association, by Dr. Fritz Zwicky, of California Institute of Technology.

Since it will be possible to achieve particle velocities of 50,000 feet per second (10 times faster than the burnout velocity of the V-2 itself), the artificial meteors are fast enough to circle the earth as nearby satellites, and some may even escape permanently from the earth's gravitational field "and thus be used to explore the interplanetary spaces." For large enough particles, Dr. Zwicky expects to be able to observe impact flashes on the moon and perhaps even on other planets. "Spectroscopic prospecting of the surfaces of the planetary bodies" he thus finds a possibility nearly within reach.

Since many of these artificial meteors may be expected to be electrically charged, the combined gravitational and electromagnetic fields of the earth will determine their trajectories at the high altitudes where aerodynamic forces are unimportant. Data obtained from observations of such extremely high-altitude meteors may help, for instance, in the interpretation of cosmic ray phenomena.

UNIVERSUM

In Vienna there are two observatories for amateur astronomers, one with an 11-inch visual refractor and 7-inch photographic instrument, the other with a reflector of eight inches and a refractor of four inches. Both are open for meetings of amateurs and public observation and instruction.

This information is supplied by *Universum,* a new popular educational magazine which has a good balance between cultural subjects, such as the arts and history, and the sciences. Astronomy is well represented, with major articles during the past year on red giants and white dwarfs, the calendar, relativity, cosmic rays, and even rockets to the moon. Numerous short notes keep up with current developments in astronomy and other sciences.

On the historic side is an article on a little-known mathematical research by Johannes Kepler. Vienna, even in his day, was famous for its wines. The amount sold was measured simply by its depth in the container (provided by the consumer) and the containers were made of valuable materials. Kepler was asked to determine the optimum shape for wine flasks — minimum area for both maximum volume and practical use (spheres *not* being practical!). This was before the days of the calculus. The pleasing result of Kepler's work on this problem, which produced a mathematical treatise, was that the shape most prevalently used was also the best.

ST. ANDREWS OBSERVATORY

In 1933, Professor Erwin Freundlich, then director of the Einstein Institut at Potsdam and international authority on relativity, resigned and left Germany. He spent several years at Istanbul, Turkey, and some months in the United States at Harvard. Finally he went to St. Andrews University in Scotland, there to build a modern observatory.

In 1940, housing for a large telescope modeled after the Einstein tower instrument was already completed. Wartime delays in constructing the telescope proved fortunate, however, for the new instrument will be a superior type of Schmidt camera, perfected by Dr. James G. Baker, of Harvard, and the Englishmen, Burch and Lindfoot.

The installation and construction are being financed jointly by the university, the Royal Society of Edinburgh, and the Carnegie Trust. One of the most important projects for the new telescope will be the study of the structure and dynamics of globular star clusters.

TWO MAGNETIC NORTH POLES?

In 1937, a Soviet scientist, B. Weinberg, advanced the hypothesis of two magnetic north poles, and in 1940 predicted that the second should be in the Sedov region of the arctic. Now a Russian geographer, M. Ostrekin, concludes that "the existence of two poles in the Arctic is no more a speculation, but a certainty," according to the Indian journal, *Science and Culture.*

In 1945, a British expedition flying over the Sverdrup Islands noted compass deviations as great as 89 degrees, and the magnetic pole was assumed to have a new location (*Sky and Telescope,* IV, 10, page 11). *Science and Culture* comments on the importance of the Soviet findings, but cautions against any final decision until an international expedition has studied the problem.

CYCLOTRON MODEL

The first new major exhibit since the war in the Hall of Science of the Griffith Observatory, Los Angeles, is a model of a cyclotron, the principal parts of which were presented to the observatory by the University of California in 1940. It had been constructed for the World's Fair at San Francisco.

The motion of a proton whirling in the opal-glass dees of the model is represented by an electric lamp on a revolving arm. By the time the lamp has reached the boundary of the model's "magnetic field," it is moving about 10 feet per second. It then appears to enter the nucleus of a lithium "atom," which is shown on a translucent screen. The "proton" joins the three "protons" and four "neutrons" and the resulting fission produces two helium "atoms."

Griffith Observatory visitors may operate the model themselves, and a six-minute recording gives an explanation of its action. The model is described in the July *Griffith Observer.*

COMET BRIGHTNESS CHANGES AND SUNSPOTS

In January, 1946, Dr. G. Van Biesbroeck, Yerkes' comet expert, observed a remarkable brightening of Comet Schwassmann-Wachmann (1925 II). Early in the month the comet had been extremely faint, but on the 25th, Dr. Van Biesbroeck was surprised to see that it had brightened to magnitude 10.2, and by the next day it reached 9.4. The "outburst" did not last long; by February 8th the comet had faded to the 15th magnitude.

More than a year later, Dr. Seth B. Nicholson, of Mount Wilson Observatory, pointed out (in the *Publications* of the Astronomical Society of the Pacific) that this remarkable behavior of the comet happened to coincide with the time that the largest sunspot ever photographed (to that time) was on the hemisphere of the sun facing the comet. As seen from the earth the sunspot was visible from January 29th to February 12th, but seen from the comet it would have been visible January 25th to February 8th. This remarkable coincidence between sunspot and cometary data strongly invites a search for other such correlations.

IAU ASTEROID CENTER

The Cincinnati Observatory, with Dr. Paul Herget director, has become the world's center of spot information on asteroids. From there the International Astronomical Union will issue *Minor Planet Circulars* (on the order of *Harvard Announcement Cards*) giving observations, discoveries, and ephemerides of asteroids. Observers are requested to communicate to the Cincinnati Observatory, Cincinnati 8, Ohio, their asteroid observations with the full accuracy with which they have been measured and reduced, even if the data and results are to be published elsewhere. Any back observations, made since 1940 and not yet published, are also desired.

The Star That Makes the Weather

By Robert R. Coles, *Hayden Planetarium*

IT IS NOT reverting to superstition to say that the future of every man, woman, and child is dependent on a star. And that star, which is more important to you and me than all the billions of others in the universe, is our sun.

Countless generations lived out their lives before man learned that the sun is a star. To them it seemed to be some special kind of celestial body, set apart from everything else in the heavens. Its importance as the source of heat and light was recognized by the ancient Chinese, the Babylonians, the Egyptians, and the Aztecs. Many of these early peoples worshipped it as a deity of supreme importance. But it was, at the same time, an object of mystery.

Today the sun is still very much of a mystery, although astronomers have learned a great deal more about it than was known to the ancients. They have learned its place in the galaxy and how it compares with other stars. They have learned something about its physical and chemical nature and have even investigated its inner workings and mechanisms.

Although perhaps not impressive when compared with some of the stars that grace our night skies, we know that the sun is the greatest force in our corner of the universe. It is the grand ruler of the solar system; by its tremendous gravity it holds the earth and other planets in their orbits. And as the sun rushes through space, at a speed of about 12 miles per second among its neighboring stars, it carries the planets with it in the general direction of the constellation Hercules. For us there is no escape from this star; our fate is dependent upon it for better or worse.

It may seem odd that the sun is described as a star. But its great apparent size and brilliance result from the fact that we are viewing it from nearby. Its distance is a mere 93 million miles while the next star beyond is over 270,000 times that far away. If we could journey out to the distance of that next nearest star, about 26 trillion miles, and look back at the sun through the most powerful telescope ever built, our star would appear merely as a point of light no different from scores of others that we see twinkling in the night sky.

Astronomers tell us that this is a typical star, larger than some, but very much smaller than others. Its diameter of 864,000 miles is not considered unusual. The star Betelgeuse, in the constellation of Orion, is about 540 times the sun's diameter, and Antares, in Scorpius, has a diameter about 330 times the sun's, according to Duncan. Nor is our sun one of the brightest stars. Betelgeuse is about 2,900 times and Antares about 1,660 times as luminous.

Compared with the earth, however, the sun is enormous. It is about 109 times the diameter of the earth or about 1,300,000 times the earth's volume. It has 333,000 times the mass of the earth. Any object on the sun would weigh nearly 28 times as much as it would on the earth; a man of 150 pounds on the earth would tip the scales at 4,200 pounds on the sun.

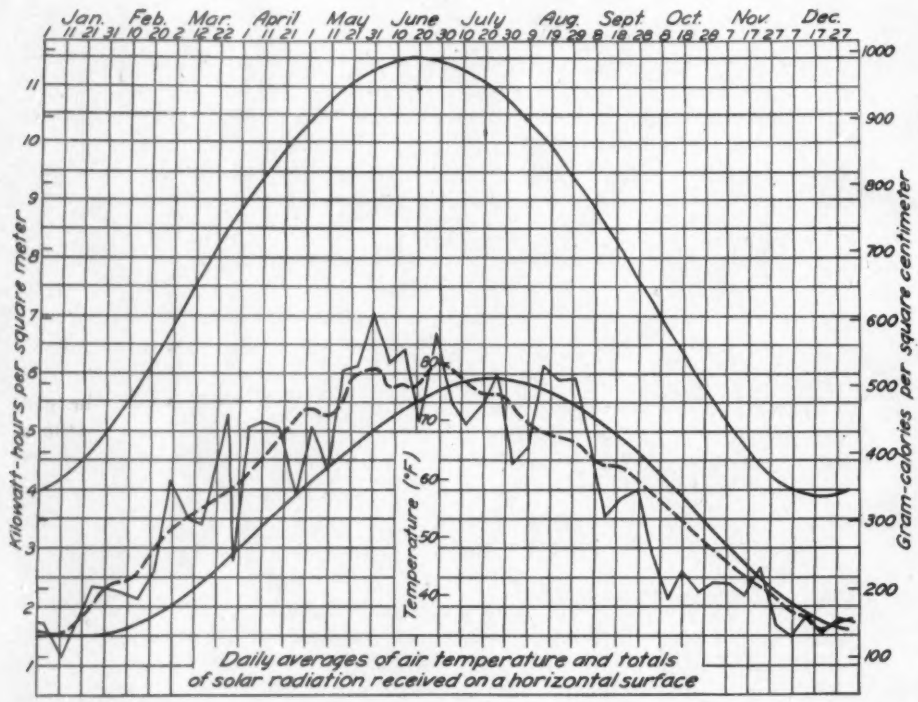
The sun is the fountainhead of practically all the energy that we enjoy. The amount of energy we receive from it is usually expressed as the solar constant, and amounts on the average to 1.938 calories per square centimeter per minute at a point outside the earth's atmosphere receiving solar rays perpendicularly. At this rate (neglecting atmospheric absorption) one square mile of the earth's surface receives maximum energy from the sun of about 4,690,000 horsepower.

Let us imagine for a moment that we are at the top of one of Manhattan's tall skyscrapers. It is evening and the final afterglow of twilight is rapidly melting in the west. Overhead, the brighter stars have already begun to appear, and two or three planets are also seen in their proper places against the background of the constellations. Not far above the southwestern horizon there hangs a crescent moon.

Even with the sun gone we find that it affects the sky picture. If its light were to be suddenly extinguished the picture would change. While the stars would shine on as brilliantly as ever, the moon and planets would disappear. Although they might continue to follow their regular orbits we would not see them because there would no longer be sunlight to reflect from their surfaces.

Now if we look down from our lofty perch, we see the steep canyons where millions of lights burn in factories, offices, and apartments. Trolleys move slowly through the streets. Buses and automobiles weave in and out like living creatures with glowing eyes. The garbled tones of a dozen or more radios float upward through the night air and mingle with the droning of a plane that heads westward above the restless city. Beneath the pavements long lines of subway cars rush madly through tunnels, carrying human cargo to and fro.

Almost all of the activities below and above us are possible because of energy received from that star 93 million miles away. Electricity and fuel oil are the immediate sources, but these are derived indirectly from the sun. Electricity must be generated, perhaps by water which is first found in oceans, lakes, and rivers. Through the energy of the sun it is evaporated and carried into the sky where it condenses into clouds. These clouds are propelled by


Jan. Feb. Mar. April May June July Aug. Sept. Oct. Nov. Dec.
Kilowatt-hours per square meter
Gram-calories per square centimeter
Temperature (°F)
Daily averages of air temperature and totals of solar radiation received on a horizontal surface

A chart of the varying amount of sunlight received in mid-northern latitudes during the year. The lag of the seasons is shown by the solid curve in the lower graph.

sun-generated winds, and when the clouds are chilled precipitation falls in the form of rain or snow. This gathers in the mountains, feeding streams that eventually flow into rivers. One of these rivers, on its way to the sea, may tumble over a steep precipice where it turns huge generators and so builds up energy. This electric current, carried by long lines, feeds the network of lights in cities, towns, and villages. It gives voice to the radio and pushes the subway trains through their underground caverns.

Or perhaps it is the energy of coal or oil that turns the generators. But we know that these are also solar energy that has been stored up for millions of years in the earth's crust. It is this indirect solar energy — fossil sunshine — that propels the cars and buses along the avenues and keeps the planes aloft.

Our daytime star supports all life, from the tiniest protozoan to the huge whales that roam the oceans. The energy from the sun makes it possible for green plants to convert the raw materials of nature into food and fuel that keep man and other animals alive. Almost every activity on the earth, from the beating of our hearts to the chaotic havoc of a hurricane, receives its impetus directly or indirectly from the sun.

As for our weather, the rotation of the earth and the varied topography of the continents have a hand in its formation, but the original cause is solar energy.

The problems of how the sun produces its energy, the importance of sunspots and their relation to earth magnetism and long-range weather forecasting, the mystery of the aurora and radio in reference to solar phenomena, and thousands of other earth-sun problems are of vital interest to all mankind.

When we consider these things, it is not surprising that many astronomers and physicists devote their lives to a study of the sun. No star is more important to man and none demands closer attention than the one that changes night into day and keeps the wheels of life turning on the earth.

LETTERS

Sir:

Referring to the question of D. A. Beekhuis, of Holland, in the August issue, as to a good book about the moon, I may recommend **Der Mond**, by Philipp Fauth, with a large map of the moon. It was edited in 1939, Breslau, Eschenhagen. I do not know if this book is now available, as I learned of it just before I left Europe. It is the result of Fauth's research on the moon during nearly 50 years — it is a good description of some hundred craters on the moon.

HERBERT LUFT
97 Fort Washington Ave.
New York 32, N. Y.

TERMINOLOGY TALKS-

J. Hugh Pruett

AROUND 110 YEARS AGO, Professor Denison Olmsted, of Yale University, very truly stated in his *School Astronomy*, "We cannot [at present] ascertain the actual distance of any of the fixed stars, but can certainly determine that the nearest star is more than 20,000,000,000,000 miles from the earth." The nearest now known is only 1¼ times greater than this. In a supplement to a later edition he wrote:

"After many fruitless and delusory efforts to measure the immense interval which separates us from the fixed stars, the great Prussian astronomer Bessel in the year 1838 determined this interesting and important element by observation on a double star in the Swan, 61 Cygni." This is the beautiful orange pair in the upper part of the Northern Cross, and a delightful object even in a 2-inch refractor. Its distance is now considered 11.1 light-years.

Parallax

We often see the term "parallax" used in connection with astronomical distances. Perhaps the definition in Webster's *Collegiate Dictionary* will give us a good starting point for an explanation. It reads: "The difference in direction of a heavenly body as seen from some point on the earth's surface, and as seen from some other conventional point, as the center of the earth or the sun."

For those not geometrically inclined, a very brief discussion of the properties of a triangle may be helpful. For simplicity, let us use a right triangle, one in which an angle (A) is a right angle, or 90° (see August Talks). The three inside angles, at A, B and C, add up to two right angles, or 180°. This is true of all triangles, no matter what their shape. In a right triangle, since one angle (A) equals 90°, the other two (B and C) together must also equal 90°. Therefore, we may say that

$A = B + C$, and $A - B = C$.

The side b extends straight up from A; let us call its direction north. If a also extended north, there would be no difference in the direction the two lines run. But as it is, the difference between their directions is angle A minus angle B, which by the simple algebra above is seen to be the angle C.

Suppose C is the location of a rock projecting above the surface of a lake, and A and B are at opposite ends of a block of sidewalk along the shore. $A - B$ is the difference in direction of the rock, the parallax as viewed from A and B. It is easily seen that the more distant this rock is, the less is the difference in direction.

Angles A and B and side c can easily be measured. Let c be 100 yards long. Now if we draw a triangle with one inch representing 100 yards, and with a protractor construct the angles A and B correctly, and extend the sides a and b until they meet at C, we shall have a triangle similar to the one supposedly existing on the lake. If on our drawn triangle the unknown side b measures two inches, the distance across the water from A to C is 200 yards. By trigonometry, b may be calculated from the values of A, B, and c without measuring a diagram — and much more accurately.

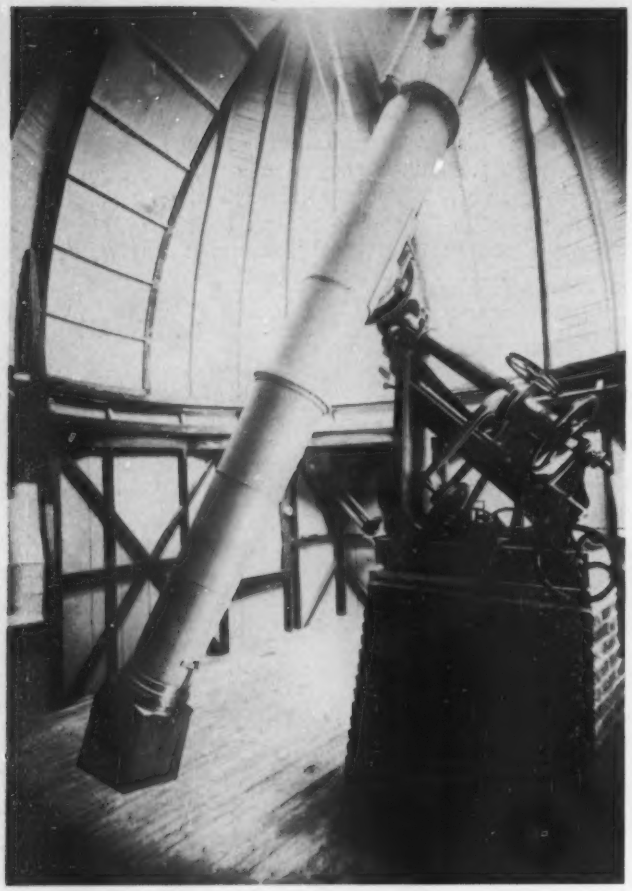
We have found a way of measuring the location of a rock in a lake without wading out into the water, so why can we not determine the distance to a heavenly body without dragging a tapeline across the starry spaces? But when we try to measure the distances to the planets, or even to the moon, we need a much longer base line than a city block, else there is so little difference in angles A and B that it cannot be detected. In the moon's case half the earth's diameter (its radius) is the base line generally designated, and the parallax is the difference in direction to some lunar point as seen from the earth's center and from a point on the surface where the moon is on the horizon. This is also equal to the angle that the radius of the earth would subtend in the eye of a moon-man, at C in our simple diagram. This angle is

almost one degree (57′) when the moon is at its mean distance.

For the inconceivably remote stars, there is no perceptible difference in direction as seen from the ends of the longest possible base line on the earth. The parallax is then defined as the difference in direction to the star as seen from the sun's center and from a point on the earth's orbit at the mean distance of the earth from the sun. The angle is again in the position of C, or the angle subtended in the eye of a hypothetical observer on the star by the mean radius of the earth's orbit. At the nearest known star this angle is only about 0°.0002 (0″.76). Only a few thousand stars are near enough to give reliable parallaxes by this method.

A Famous Old Telescope Goes to China

By Dorrit Hoffleit
Harvard College Observatory



The 11-inch Draper refractor, as it appeared more than 50 years ago, when this photograph was taken. The objective end is near the floor and bears the casings which hold the objective prisms.

SUN YATSEN University Observatory was founded in Canton, China, in 1929, by Professor Chang Yuin, for educational and research purposes. Its two principal instruments were a transit and a 6-inch refractor. By 1935 the observatory had moved to new and more spacious quarters six miles outside of the city and had acquired an 8-inch Zeiss equatorial. At the time of the Japanese invasion about 10 years ago, most of the observatory's equipment was lost, although the building still remains. It is situated at longitude 112° 54′ east, latitude 23° 6′ north.

To help fill the need of students of astronomy in China and to strengthen the bonds of friendship and co-operation with our Chinese colleagues, Harvard College Observatory has offered Dr. Chang (now visiting this country) the historic 11-inch Draper refractor on a long-term loan. The Chinese of Boston have contributed funds sufficient for dismantling, rehabilitation, and shipment of the instrument to Canton. As few, if any, of the Boston Chinese have a major interest in astronomy, these contributions are gratifyingly symbolic.

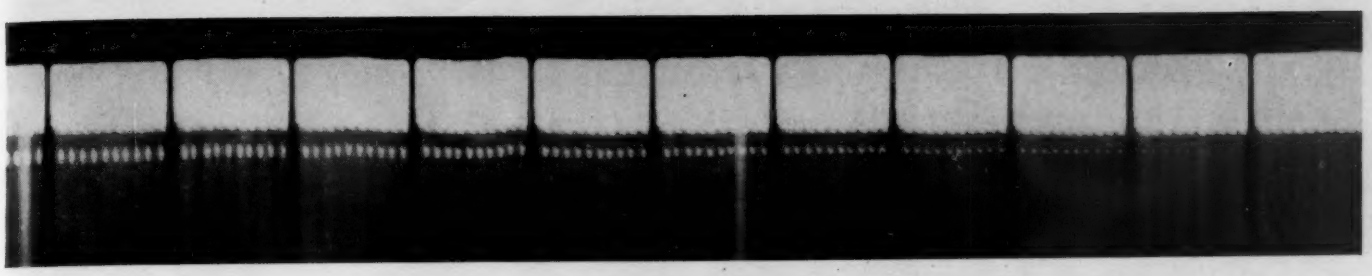
For several generations, the 11-inch Draper has had a distinguished and worthwhile career. Built by Alvan Clark for the Lisbon Observatory, it was actually acquired by Dr. Henry Draper in 1880 for his observatory at Hastings-on-Hudson. It is a visual refractor equipped with a photographic correcting lens, has a focal length of 153 inches, and gives photographs having a scale of 53 seconds of arc per millimeter. With it Dr. Draper secured the first photograph ever made of the Orion nebula. He succeeded in exhibiting details equivalent to 14.7 magnitude. He also used the telescope to obtain spectra of the nebula and of other objects, notably the comet of 1881. These pictures were made some time before astronomical photography became regular routine practice at any observatory.

After Henry Draper's premature death (at the age of 45) in 1882, his widow was eager to establish a memorial to him, one which would advance knowledge of stellar spectroscopy, the field in which he pioneered so successfully and promisingly. In addition to her generous grants and numerous gifts of equipment, Mrs. Draper first lent the 11-inch in 1886, and later donated the telescope to the observatory.*

A niece of Dr. Draper, Antonia C. Maury, was assigned the project of classifying and analyzing the spectra taken with the 11-inch. The telescope was then equipped with four objective prisms which could be used either singly or in combination; all four together yielded spectra fully four inches long, showing in some instances several hundred lines. Most spectra, however, were taken with a single prism giving a dispersion of about 50 angstroms per millimeter. Miss Maury spent some seven or eight years examining and measuring nearly 5,000 spectra. Her extremely detailed two-dimensional system of classification, published in 1897, proved a mine of data for astrophysics. The symbols she used were later shown to have differentiated not only between stars of different temperature (as the usual system adopted by Annie J. Cannon does) but among stars of the same class according to their luminosities.

*Spectra for the monumental *Henry Draper Memorial Catalogue* were taken mainly with two 8-inch doublets, one in the Northern and one in the Southern Hemisphere. The northern instrument, called the 8-inch Draper, is also a Clark telescope and the gift of Mrs. Draper. It, too, is helping resurrect astronomy in a war-torn land. Recently it was sent to Poland for the new Copernicus Observatory at Torun.

The new buildings of the Sun Yatsen Observatory, showing portions in the process of construction, photographed on April 17, 1937.

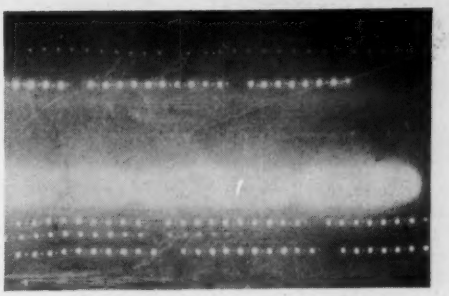


An occultation of Saturn photographed with the 11-inch Draper on July 10, 1900. Sixty exposures were taken each minute, so the total time for the rings to immerse completely was about 1½ minutes; the earlier pictures are at the left.

Perhaps the most spectacular work of the 11-inch was in the discovery of spectroscopic binaries. In 1889, E. C. Pickering noticed that the high-dispersion spectra of Mizar showed sometimes single, sometimes double lines. This he interpreted as a Doppler effect in a revolving binary system, one star moving toward the observer while its companion moved away. Hence, the lines corresponding to the approaching star were displaced to the violet while those of the other were shifted to the red. Soon after Pickering's discovery, Miss Maury found Beta Aurigae to be a similar binary, and so a new field in astronomy was opened.

In later years, Miss Maury used spectra taken with the 11-inch for her very extensive study of the eclipsing (as well as spectroscopic) binary Beta Lyrae, a star which has a wealth of unusual characteristics. Right up to the present, the 11-inch has been used to take spectra of this star for Miss Maury, so that her predictions on its behavior might be checked.

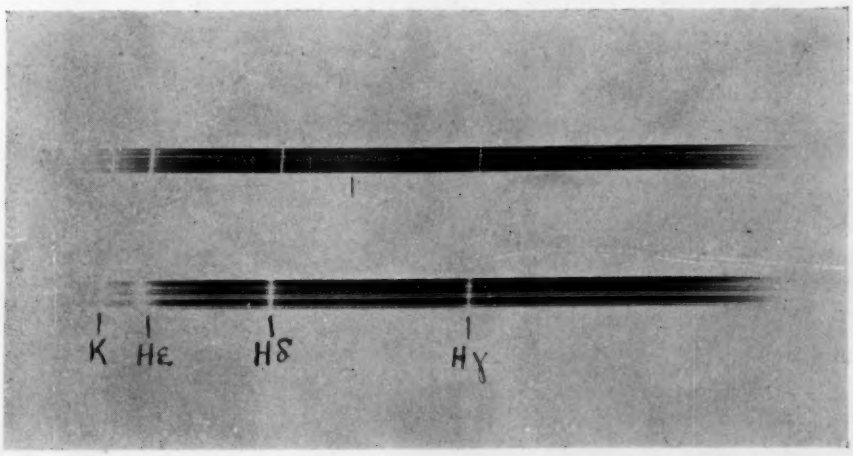
Without the prisms (which are staying at Harvard where they are in use on other telescopes) the 11-inch has done much other important work. In the '90's, E. S. King used it to study the eclipses of Jupiter's satellites photographically; also for occultations of stars and of Saturn. Later, King's important photometric studies, "absolute" measures of photographic magnitudes, were carried out with this instrument. For many years



An eclipse of Jupiter's satellite IV, on December 3, 1896, photographed by Edward S. King with the 11-inch Draper telescope. The disappearing satellite is second from the bottom; Jupiter is a blur of light.

the telescope was on a visit to Jamaica, British West Indies, where W. H. Pickering used it for visual observations of the planets. Students at Harvard have frequently employed the larger Draper instrument to good advantage.

Some of us are a little wistful at seeing the famous, faithful old telescope leave our observatory. It has never ceased to be useful, except for the interference of city lights in recent years, and it has been a link with the glories of the past. We wish it bon voyage and an illustrious future, especially in education where it is so desperately needed. If it is successful in inspiring the youth of China to higher learning and astronomical research, it will achieve the major goal now set for it.



A pair of 4-prism spectra taken with the 11-inch Draper telescope on September 8, 1887. Below is Altair, a dwarf star of type A5 with the lines of hydrogen broadened as in the sun. Above is Deneb, type A2, showing the narrow lines characteristic of giant stars. Harvard Observatory photographs on this page.

ANTARES' COMPANION

After waiting since 1940 for ideally perfect conditions, Dr. Otto Struve, of Yerkes and McDonald observatories, has finally succeeded in getting the spectra he desired for solving a mystery of the spectrum of the faint blue companion of Antares. About 10 years ago, Wilson and Sanford at Mount Wilson observed emission lines of forbidden iron in this star, which is only three seconds of arc distant from the bright, red primary. Dr. Struve oriented the slit of his spectrograph at the 82-inch McDonald telescope at right angles to the line of separation of the two stars.

What he found was that the emission lines extended "like little black arrows" on both sides of the continuous spectrum of the faint star. They resembled the hydrogen lines in W. W. Campbell's famous "hydrogen envelope star." It is evident that Antares' companion is surrounded by a nebula giving rise to the forbidden iron lines. This nebulosity appears about five seconds of arc in diameter, but it is enormously large, about 150 times the diameter of Antares, or 10 times the distance across our solar system. The companion of Antares which it surrounds is presumably only one or two times the sun's diameter.

It is the light of the faint blue star, not Antares, that excites the nebulosity to shine. One puzzle about the spectrum of the nebulosity is the complete absence of any lines other than the forbidden iron lines. In the spectra of ordinary gaseous nebulae hydrogen lines are very prominent. Dr. Struve suggests that this may not be strictly a gaseous envelope but one consisting of solid, "perhaps even meteoric particles, which have long ago lost most of their hydrogen and are rich in iron." The radiation from this "iron curtain" nebula would then correspond more closely to comet radiations than to those of gaseous nebulae.

ASTRONOMICAL LEAGUE

By an amendment to its by-laws, the Amateur Astronomers League has changed its name to Astronomical League. The Asociacion Argentina "Amigos de la Astronomia" of Buenos Aires, with some 800 members, has applied for membership.

HERE AND THERE WITH AMATEURS

This is not intended as a complete list of societies, but rather to serve as a guide for persons near these centers, and to provide information for transplanted amateurs who may wish to visit other groups. The asterisks denote societies whose members receive *Sky and Telescope* as a privilege of membership. The daggers denote societies which are members of the Astronomical League.

City	*Organization*	*Date*	*P.M. Season*	*Meeting Place*	*Communicate with*
ANN ARBOR	*ANN ARBOR A.A.A.	2nd Mon.	7:30 Oct.-June	U. of Mich. Obs.	Miss E. McLaughlin, 1214 W. Wash., 22885
BADEN, PA.	†*BEAVER CO. A.A.A.	2nd Tue.	8:00 Sept.-June	Private homes	Mrs. R. T. LuCaric, Bx. 463, *Baden* 2365
BATTLE CREEK	B. C. A. A. CLUB	2nd Fri.	8:00 Oct.-June	Battle Creek Museum	Mrs. W. V. Eichenlaub, 47 Everett St.
BROOKLYN, N. Y.	ASTR. DEPT., B'KLYN INST.	Rd. Table 3rd Thu.	8:15 Oct.-April	Brooklyn Inst.	William Henry, 154 Nassau St., N. Y. C., *BA.* 7-9473
BUFFALO	*A.T.M.S & OBSERVERS	1st, 3rd Wed.	7:30 Oct.-June	Mus. of Science	J. P. Dow, E. Main St., R. D. 3, E. Aurora
CAMBRIDGE	†*BOND AST. CLUB	1st Thu.	8:15 Oct.-June	Harvard Obs.	Miriam Dickey, Harvard Observatory
"	†*A.T.M.S OF BOSTON	2nd Thu.	8:00 Sept.-June	Harvard Obs.	A. G. Hall, 206 Maplewood St., Watertown
CHATTANOOGA	BARNARD A. S.	2nd Fri.	8:00 Oct.-May	Jones Observatory	C. T. Jones, 302 James Bldg., *CHat.* 7-1936
CHICAGO	†*BURNHAM A. S.	2nd Tue.	8:00 Sept.-June	Chi. Acad. of Sciences	J. M. Showalter, 6200 Kenmore Ave.
"	CHICAGO A. S.	Monthly	8:00	Adler Planetarium	Adler Plan., *Wabash* 1428
CINCINNATI	*CIN. A. A.	2nd Fri.	8:00 Sept.-June	Cincinnati Obs.	T. R. Stoner, RR 8, Cin. 30, *BE* 7937-R
"	*CIN. A. S.	2nd Wed.	....	5556 Race View Ave.	A. H. Hasemeier, 2945 Ravogli Ave.
CLEVELAND	CLEVELAND A. S.	Fri.	8:00 Sept.-June	Warner & Swasey Obs.	Virginia Burger, Warner & Swasey Obs.
COLUMBIA, S. C.	NORTH'N CROSS A.S.	Every Mon.	8:15 All year	Melton Observatory	Dr. L. V. Robinson, Univ. of S. C.
COLUMBUS, OHIO	COLUMBUS A. S.	Last Tue.	8:00 All year	McMillin Obs.	J. A. Hynek, Ohio State Univ.
DAYTON	A.T.M.S OF DAYTON	3rd Sat.	Eve.	Private homes	W. C. Braun, New Lebanon
DAYTONA BEACH	D. B. STARGAZERS	Alt. Mon.	8:00 Nov.-June	500 S. Ridgewood Ave.	Rolland E. Stevens, 500 S. Ridgewood
DETROIT	†*DETROIT A. S.	2nd Sun.	3:00 Sept.-June	Wayne U., Rm. 187	E. R. Phelps, Wayne University
"	†*N. W. DETROIT A.S.	1st Tue.	8:00 Sept.-June	Redford High Sch.	John W. Broxholm, 21412 Pickford
DULUTH, MINN.	†*DARLING AST. CLUB	1st, 3rd Fri.	8:00 All year	Darling Observatory	Sam M. Cox, 127 N. 10 Ave. E., *Hem.* 4827
FT. WORTH	TEX. OBSERVERS	No regular meetings			Oscar E. Monnig, 1010 Morningside Dr.
GADSDEN, ALA.	ALA. A. A.	1st Thu.	7:30 All year	Ala. Power Audit.	Brent L. Harrell, 1176 *W* or 55
GENEVA, ILL.	*FOX VALLEY A. S.	3rd Tue.	8:00	Geneva City Hall	Joseph Zoda, 501 S. 6th, St. Charles
HOUSTON	*HOUSTON A. S.	Last Fri.	7:30 All year	Mus. Nat. Hist. Annex	W. D. Martin, 1810 Sunnyland St.
INDIANAPOLIS	†INDIANA A. S.	1st Sun.	2:15 All year	Odeon Hall	E. W. Johnson, 808 Peoples Bank Bldg.
JACKSONVILLE	*J. A. A. C.	1st, 3rd. Mon.	8:00 All year	Private homes	E. L. Rowland, Jr., 442 St. James Bldg.
JERSEY CITY, N. J.	†REVERE BOYS CLUB	Mon., Tue.	7:15 All year	Gregory Mem. Obs.	Enos F. Jones, 339 Wayne St.
JOLIET, ILL.	†JOLIET A. S.	Alt. Tue.	8:00 Oct.-May	Jol. Mus. & Art Gall'y	Mrs. Robert L. Price, 403 Second Ave.
KALAMAZOO	†KALAMAZOO A.A.A.	Sat.	8:00 Mar.-Dec.	Private homes	Mrs. G. Negrevski, 2218 Amherst, 31482
KEY WEST, FLA.	†KEY WEST AST. CLUB	1st Wed.	8:00 All year	Private homes	W. M. Whitley, 1307 Div. St., 724-R
LOS ANGELES	L.A.A.S.	2nd Thu.	8:15	2606 W. 8th St.	A. M. Newton, 2606 W. 8th St.
LOUISVILLE, KY.	†L'VILLE A. S.	1st Tue.	8:00 Sept.-May[1]	Univ. of Louisville	B. F. Kubaugh, 621 34th St.
MADISON, WIS.	†MADISON A. S.	2nd Wed.	8:00 All year	Washburn Obs.	Dr. C. M. Huffer, Washburn Obs.
MEMPHIS	A.T.M.S OF MEM.	Meetings suspended			R. E. Wendt, Jr., 2084 Linden Ave.
MIAMI, FLA.	SOUTH'N CROSS A.S.	Every Fri.	7:30 All year	M. B. Lib. Grounds	A. P. Smith, Jr., 426 S.W. 26th Road
MILWAUKEE	†*MILW. A. S.	1st Thu.	6:15 Oct.-May[2]	City Club	E. A. Halbach, 2971 S. 52 St., W. Allis
MOLINE, ILL.	†*POP. AST. CLUB	Wed.[3]	7:30 Feb.-Nov.	Sky Ridge Obs.	Carl H. Gamble, Route 1
NASHVILLE	BARNARD A. S.	2nd Thu.	7:30 All year	Vanderbilt Univ.	E. Keller, 2106 15th Ave. S.
NEW HAVEN	†NEW HAVEN A.A.S.	4th Sat.	8:00 Sept.-June	Yale Obs.	J. J. Neale, 29 Fairmont Ave.
NEW ORLEANS	A.S. OF N. ORLEANS	Last Wed.	8:00 Sept.-May	Cunningham Obs.	Dr. J. Adair Lyon, 1210 Broadway
NEW YORK	*A.A.A.	1st Wed.	8:15 Oct.-May	Amer. Mus. Nat. Hist.	G. V. Plachy, Hayden Plan., *EN.* 2-8500
"	†JUNIOR AST. CLUB	3rd Sat.	Aft. Oct.-May	Amer. Mus. Nat. Hist.	J. B. Rothschild, Hayden Plan., *EN.* 2-8500
NORFOLK, VA.	†*A.A.S. OF NORFOLK	2nd, 4th Thu.	8:00 All year	635 W. 29th St.	P. N. Anderson, 635 W. 29th St.
NORWALK, CAL.	EXCELSIOR TEL. CLUB	Thu.	7:00 All year	Excelsior Union H. S.	Geo. F. Joyner, 410 Sproul St.
NORWALK, CONN.	NORWALK AST. SOC.	Last Fri.	8:00 Sept.-June	Private houses	Mrs. A. Hamilton, 4 Union Pk., 6-5947
OAKLAND, CAL.	†*EASTBAY A. A.	1st Sat.	8:00 Sept.-June	Chabot Obs.	Miss H. E. Neall, 1626 Chestnut, B'keley
OWENSBORO, KY.	†*OWENSBORO A. C.	3rd Sat.	8:00 All year	Public Library	Herman Batt, 1507 Hathaway St.
PALO ALTO, CAL.	*AST. & TEL. CLUB	1st, 3rd. Fri.	7:30 All year	Community Center	Marvin J. Vann, 301 Oxford Ave.
PHILADELPHIA	A. A. OF F. I.	3rd Fri.	8:00 All year	The Franklin Inst.	Edwin F. Bailey, *Rit.* 3050
"	*RITTENHOUSE A. S.	2nd Fri.	8:00 Oct.-May	Morgan Physics, U. Pa.	Sarah Lippincott, Sproul Obs., Swarthmore
PITTSBURGH	†*A.A.A. OF P'BURGH	2nd Fri.	8:00 Sept.-June	Buhl Planetarium	Louis E. Bier, 837 Estella St.
PONTIAC, MICH.	*PONTIAC A.A.A.	2nd Thu.	8:00 All year	Private homes	Mrs. M. Chircop, 147 Prospect St., 21455
PORTLAND, ME.	†A. S. OF MAINE	2nd Fri.	8:00 All year	Private homes	H. M. Harris, 27 Victory Ave., S. Portland
PORTLAND, ORE.	†*PORTLAND A. S.	1st Wed.	7:00 All year	Central Pub. Lib.	H. J. Carruthers, 427 S. E. 61 Ave.
"	†A. T. M. & O.'s	2nd Tue.	8:00 All year	Private homes	N. C. Smale, 831 N. Watts St.
PROVIDENCE, R. I.	SKYSCRAPERS, INC.	Mon. or Wed.	8:00 All year	Ladd Observatory	Ladd Obs., Brown U., *GA.* 1633
RENO, NEV.	A. S. OF NEV.	4th Wed.	8:00 All year	Univ. of Nevada	G. B. Blair, University of Nevada
ROCHESTER, N. Y.	ROCH. AST. CLUB	Alt. Fri.	8:00 Oct.-May	Univ. of Rochester	Edwin M. Root, 110 Hamilton St.
ROCKY MOUNT, N.C.	HI-Y A. C.	Tue.	8:00	YMCA	J. A. Harper, YMCA
SACRAMENTO	SAC. VAL. A. S.	.....	8:00 All year	Sacramento College	Miss E. Champ, 3816 Sac'to Blvd., 5-9116
SAN DIEGO, CAL.	AST. SOC. OF S. D.	1st Fri.	7:30 Oct.-June	504 Elec. Bldg.	W. T. Skilling, 3140 Sixth Ave.
"	†A.T.M. AST. CLUB	2nd, 4th Mon.	7:30 All year	3121 Hawthorn St.	G. A. Sharpe, 4477 Muir, *Bayview* 3757
SCHENECTADY	S'TADY AST. CLUB	3rd Mon.	8:00 All year	Schenectady Museum	G. Staffa, 32 Front St.
SOUTH BEND, IND.	ST. JOS'PH VAL. AST.	Last Tue.	8:00 All year	928 Oak Street	F. K. Czyzewski, South Bend Tribune
SPRINGFIELD, VT.	SPRINGFIELD T. M.'s	1st Sat.	6:00 All year	Stellafane	John W. Lovely, 27 Pearl St., 535-W
ST. LOUIS	ST. LOUIS A. A. S.	1st Sat.	..... All year	Private homes	A. M. Obrecht, 2913 Park Ave.
TACOMA, WASH.	TACOMA A. A.	1st Mon.	8:00 All year	Coll. of Puget Sd.	Dorothy E. Nicholson, 2816 No. Union Ave.
TEANECK, N. J.	†BERGEN CO. A. S.	2nd Wed.	8:30 All year	Obs., 107 Cranford Pl.	J. M. Stofan, 332 Herrick
TULSA, OKLA.	†TULSA A. S.	Occasional meetings			V. L. Jones, 4-8462
WANTAGH, N. Y.	LONG ISLAND A. S.	Sat.	8:00 All year	Private homes	A. R. Luechinger, Seaford Ave., 1571
WARREN, OHIO	†MAHONING VAL. A.S.	Thu.[4]	8:00 All year	Private homes	S. A. Hoynos, 1574 Sheridan, N.E., 25034
WASHINGTON, D.C.	†NAT'L CAP. AST'MERS	1st Sat.	8:00 Sept.-June	U.S. Nat'l. Museum	Jewell Boling, 1717 P St. N.W., *Du.* 2969
WICHITA, KANS.	†*WICHITA A. S.	1st Wed.	8:00 All year	To be announced	Dollie Ratcliff, 801 Maple, 2-1822
WORCESTER, MASS.	†*ALDRICH AST. CLUB	2nd Tue.	7:30 All year	Mus. Natural History	Ruth Foley, 9 Oberlin St., 63101
YAKIMA, WASH.	YAK. AM. AST'MERS	1st Tue.	8:00 All year	Cha. of Comm. Bldg.	Edward J. Newman, 324 W. Yakima Ave.

[1]June, Jul., Aug., informal meetings. [2]Dinner meeting. [3]Nearest 1st-quarter moon. [4]1st or 2nd Sun., June-Sept.

Amateur Astronomers

West Coast Amateur Astronomer Dies

AMATEUR telescope makers, because of their skill, often become proficient opticians and astronomers. Among the leading ones of this nation was Harold A. Lower, of San Diego, Calif., whose death on August 23rd brought to a close a chapter in practical amateur astronomy. With his father, Mr. Lower formed a team which not only constructed first-grade optical equipment but also used it to great advantage.

Their first telescope adventure was a 6-inch Newtonian. This was followed with an excellent 8½-inch, which was used extensively for the moon and the planets. They then constructed two 12-inch reflectors, one a Newtonian, the other a long-focus Cassegrainian. Schmidt cameras, with their difficult correcting plates, presented a challenge to the Lowers, and they built three Schmidts, one an f/1, the other two f/1.5. Two of these cameras are at the San Diego State College; the other is at Lowell Observatory in Flagstaff, Ariz.

With the Schmidt began a regular program of photographing the Milky Way. About 300 excellent negatives cover the Milky Way of the northern heavens. The program called for going south in order to photograph the southern Milky Way, thus making a complete series, but World War II prevented carrying out this plan.

The Lowers pioneered in photographing with red filters. They observed a nebula in the constellation of Orion which has been named the Lower nebula after them.

Articles by Harold Lower have appeared in many popular and technical magazines, and his correspondence included every state in the union and many foreign countries. He was always willing to help the amateur with his problems, and effectively served to advance the cause of astronomy.

RUDOLPH M. LIPPERT
San Diego, Calif.

Astronomy Illustrated and a New Planetarium Projector

Astronomy has considerable space devoted to it in the September issue of the magazine *Science Illustrated*. There is a short article by Dr. George Gamow, of George Washington University, on "The Sun's Atomic Fuel," in which he describes the carbon cycle of solar energy generation.

Another article is entitled, "Mr. Spitz Brings Science Down to Earth." It tells of the sparetime inventions of Armand Spitz, director of museum education at Philadelphia's Franklin Institute and a lecturer at the Fels Planetarium. First of these is an inexpensive star projector which works on the principle of pinhole projection from a small light-bulb source. Another is a low-cost seismograph, and there are also inexpensive orreries and weather instruments. Amateurs who attended the recent convention in Philadelphia will recall that Mr. Spitz was chairman of the committee which planned and conducted the event.

Harold Lower (right) and his father with their apparatus for photographing the northern Milky Way. A two-pier mounting carries two cameras and one guide telescope on a single polar axis.

THIS MONTH'S MEETINGS

Chicago: Members of the Burnham Astronomical Society will hold a symposium on telescopes at the Tuesday, November 11th meeting. Five speakers will participate. This is also the annual meeting, and there will be election of officers. It will take place at the Chicago Academy of Sciences Auditorium at 8:00 p.m.

Cincinnati: Dr. James Cuffey, of Kirkwood Observatory at Indiana University, will address the Cincinnati Astronomical Association on Friday, November 14th, on "Galactic Building Blocks: Stars and Star Clusters." The meeting place is to be announced.

Detroit: Dr. Freeman D. Miller, of the University of Michigan Observatory, will discuss "Stellar Societies" at the meeting of the Detroit Astronomical Society on Sunday, November 9th, 3 p.m. at Wayne University. He will outline recent thought on the manner in which various types of stars are grouped, rather than indiscriminately mingled in space.

Geneva, Ill.: The Fox Valley Astronomical Society will meet at the Geneva City Hall at 8 o'clock on November 4th, Tuesday, to hear a symposium on Mars, in which three speakers will take part.

The annual banquet of the society is scheduled for Saturday, November 15th at 7 p.m. in the Geneva City Hall. Dr. Thornton L. Page, University of Chicago, will be guest speaker, his subject, "Exploring the Universe."

Indianapolis: "The Sun's Family" will be described by Emsley W. Johnson at the November 2nd meeting of the Indiana Astronomical Society, 2:15 p.m. at Odeon Hall.

Kalamazoo: On November 8th, meeting at the Science Hall of Kalamazoo College, the Kalamazoo Amateur Astronomy Association will hear a discussion of "The Stratosphere" by Dr. John Hornbeck. Election of officers is also scheduled.

Madison: A symposium on meteors, with three speakers, will be held at the November 12th meeting of the Madison Astronomical Society at Washburn Observatory, at 8 o'clock.

New York: Dr. Charlotte Moore Sitterly, of the National Bureau of Standards, will speak on "Stellar Spectra" at the November 5th meeting of the Amateur Astronomers Association at 8:00 in the American Museum of Natural History.

Pittsburgh: At the November 14th meeting, George Seibel, director of the Carnegie Free Library of Allegheny, will speak on "Lessons Learned from the Stars." The Amateur Astronomers Association meets in the Buhl Planetarium at 8 o'clock.

San Diego: E. E. Woolsey will speak to the San Diego Astronomical Society on Friday evening, November 7th, at 7:30 p.m., Room 507, Gas and Electric Building, on "Astronomy's Foundation," discussing Copernicus, Tycho, Kepler, Galileo, and Newton.

Washington, D. C.: Dr. A. C. Poling, of the division of geodesy of the Coast and Geodetic Survey, will be guest lecturer at the monthly meeting of the National Capital Astronomers on Saturday, November 1st, at 8 p.m., in the National Museum. In his talk, "What Way Is Up," Dr. Poling will discuss the differences in the vertical line in astronomical and geodetic work.

In Focus

FREDERICK K. VREELAND, of Mill Valley, Calif., has taken an unusual photograph of circumpolar star trails, an enlargement of which appears on our back cover this month. Herewith is a portion of the center of the picture which is enlarged about 2½ times to show 18 stars of the Harvard north polar sequence of standard stars of spectral class **A**. Stars as faint as 13.5 are shown on the original negative.

The picture was taken with an aerial camera made for war use; 8 x 10 Super XX cut film was used, resulting in good rendition of the red stars (Dektol developer, 4½ minutes). The lens is a 4-inch anastigmat of 13½ inches focus, focal ratio f/3.5, fluoride coated. The camera was mounted on the ground and the overall exposure was 13 minutes, with a minute out to shield the lens from the light of a passing car.

Mr. Vreeland writes: "The picture was made on a spur of Mount Tamalpais near here, which is 15 miles north of the Golden Gate. The night was a rather good specimen of California weather which, as you may have heard, is of only two kinds — perfect and unusual."

On the negative Mr. Vreeland has counted 116 stars nearer the pole than Polaris, which is the bright round spot near the back-cover center. Below and to the left ⅜ inch is a pin prick, round, small, and sharp, which marks the position of the north celestial pole in 1900. The present position of the pole is at the center of the star trail arcs, and the shift of the pole since 1900 is easily noted. This also shows well on the enlargement.

The stars in the handle of the Little Dipper, Delta and Epsilon Ursae Minoris, are toward the left and slightly higher than Polaris, spaced roughly 1½ inches apart. Gamma Cephei is nearly 4 inches above Polaris, at an angle of about 22 degrees to the right. Nearly 25 degrees are covered diagonally on the original negative. Enlargement and reproduction have introduced a number of defects not in the original.

The central portion of the back-cover picture, enlarged 2½ times from the original negative to show stars of the Harvard polar sequence. These have the following photographic magnitudes:

1	4.48	10	9.02
2	5.28	11	9.55
3	5.81	12	9.86
4	5.99	13	10.30
5	6.49	14	10.65
6	7.11	15	11.08
7	7.31	16	11.40
8	8.23	17	11.63
9	8.83	18	12.06

Polaris is the large overexposed star near No. 5, and the 1900 pole position is the white dot near No. 18. Photo by Frederick K. Vreeland.

An Exhibit by Amateurs at the Sacramento State Fair

From August 8th to September 7th, the Sacramento Valley Astronomical Society conducted an astronomical exhibit at the Sacramento State Fair. Some eight telescopes ranging in size from 10 to 2½ inches were on display; also a 12-inch mirror and an unfinished 16-inch mirror. Mirror making was demonstrated on a barrel covered with a chart of astronomical data, supplied by Lorraine Todd.

About 150 really interested persons signed the guest register during the exhibit. This picture was taken by McCurry Foto Company.

Northwest Astronomical Societies Visit Victoria Observatory

Eighteen members from four societies in Oregon and Washington journeyed to Victoria, B. C., to spend the evening and early part of the night of August 16th at the Dominion Astrophysical Observatory, situated nine miles north of the capital city of British Columbia. Members of the party traveled by various means, some by auto and ferry, a few by plane, but most by train and steamship. The trip to and from the observatory was made by chartered bus. Societies represented were the Portland Amateur Telescope Makers and Observers, the Portland Astronomical Society, the Yakima Amateur Astronomers, and the Spokane Amateur Telescope Makers.

The visitors met Dr. J. A. Pearce, director of the observatory, and some of his staff, who demonstrated and explained the various instruments and equipment. It happened to be public observation night and, as the sky was clear, a considerable crowd assembled; but before and after the public demonstration the visiting amateurs were shown the operation of the spectrograph of the 72-inch reflector, fourth largest telescope in the world.

AMERICAN ASTRONOMERS REPORT

Here are highlights of some papers presented at the 77th meeting of the American Astronomical Society at Dearborn Observatory in September. Complete abstracts will appear in the Astronomical Journal.

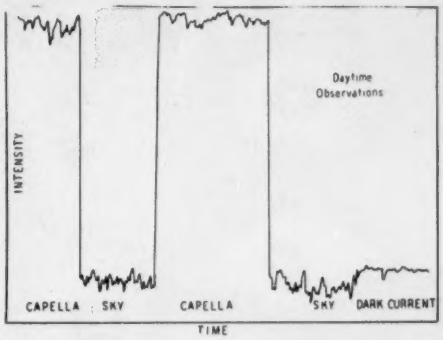
Prominences in Stars

RECENT OBSERVATIONS of the eclipsing binary UX Monocerotis, whose unusual properties were first described by Dr. S. Gaposchkin, of Harvard Observatory, throw new light upon the question of the origin of gaseous streams, rings, and shells which exist in many close binary systems and in some peculiar single stars. UX Monocerotis consists of a large, fairly massive *G*-type star and a small, less massive *A* star. The orbital velocities (considered circular) are 60 and 140 kilometers per second, respectively. During the total eclipse, when the yellow star completely hides the white one, conspicuous, broad, but somewhat shallow absorption lines of ionized calcium give a velocity toward the observer of 250 kilometers per second, thus revealing the existence of a mass of gas which flows away from the *G* star.

At the times between eclipses, when the two stars are "seen" side by side, one approaching, the other receding from us, the lines of the element hydrogen are usually double, with fairly sharp components. The lines of ionized calcium are also often double, but the radial velocities of the calcium and hydrogen components are not always the same. These peculiar lines undergo rapid changes in intensity and displacement.

Dr. Otto Struve, of Yerkes and McDonald observatories, proposes that both components of UX Monocerotis are active in the formation of prominences. The advancing hemisphere of the *G* star accounts principally for outflowing prominences rich in observable ionized calcium; the *A* star for prominences rich in hydrogen.

In previous work on the gaseous streams and rings of eclipsing stars, Dr. Struve had been unable to decide whether such material was being replenished or was there from the time of the formation of the binary involved. Peculiar to itself though UX Monocerotis may be, he now feels that all of these tenuous formations are being replenished by prominences from one or both stars. Prominence action may also be the mechanism for the escape of gas from the equatorial regions of rapidly rotating single stars; and the enormously extended atmospheres of supergiants, such as Deneb in Cygnus, may be caused by vast fields of prominences. This conclusion had already been reached by Dr. D. H. Menzel, of Harvard Observatory, by an entirely different process of reasoning.



Light from the star Capella, observed with the sun 45 degrees away, by means of apparatus devised at Amherst College.

Star Brightnesses by Day

"PHOTOELECTRIC Photometry of Bright Stars in Full Daylight" was the title of a paper by Dr. John S. Hall, of Amherst College, in which he described observations which practically eliminate the sky background as a factor in magnitude measurements by day or night. The light from the sky that strikes the photosensitive surface of a 1P21 photomultiplier tube or of an infrared-sensitive lead sulfide cell is maintained constant while the starlight is made to vary at a fixed frequency. The variable photocurrent caused by the star is then amplified by a tuned-frequency current amplifier while the steady (but very much larger) photocurrent caused by the sky is rejected.

One method of doing this is to use a rotating disk in the focal plane of the telescope. This disk has two similar holes equidistant from and on opposite sides of the center of the disk, and the star is so placed that its light passes first through one hole and then the other to produce the modulated energy.

Dr. Hall has used both the photomultiplier and the lead sulfide cell attached to the 18-inch refractor at Amherst College. A signal 25 times the average random fluctuations has been obtained with the 1P21 from Capella. This was done at local apparent noon, when the star was 45 degrees from the sun in the sky. A red filter was used to reduce the predominantly blue light of the sky, but with the infrared-sensitive cell the sky light did not noticeably affect the measures of the brightness of the star under observation.

Dr. Hall pointed out that equally good measures of this kind can be made day or night, but the principal difficulty is that of finding the star in the daytime. Only the brightest stars are seen easily by visual means through a telescope by day.

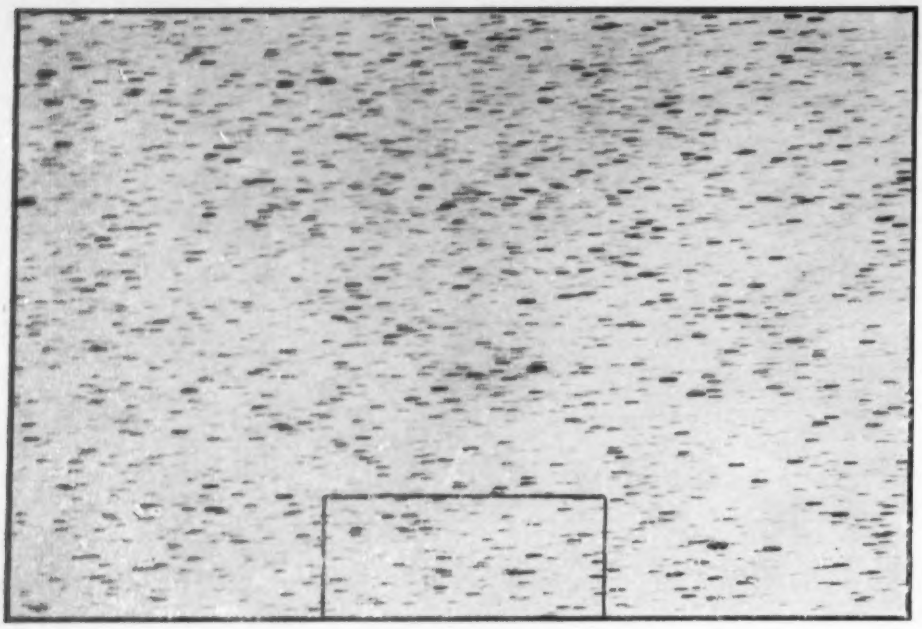
The Amherst astronomer suggested three possible uses for the new method: 1. To measure the magnitudes of faint stars in a moonlit sky, especially of variable stars which might be having important changes unobservable by other means at such times. 2. To observe the transits of stars by day or night. 3. To monitor the transparency of the sky by continuously observing the same star, preferably Polaris. An arrangement for making transparency observations is now being designed at Amherst; such a program is of importance to meteorologists as well as to astronomers.

Infrared spectra of late-type stars taken with a 4-degree objective prism attached to the Schmidt-type telescope of the Warner and Swasey Observatory. (See spectra fields on pages 14 and 15.)

Infrared Spectra

VERY LUMINOUS *B*-type stars, seen at great distances, have furnished one of the principal means of studying the structure of the Milky Way galaxy. But on the faint spectra of distant stars the helium lines whereby a hot *B* star is detected are difficult to see, so that the most distant of such stars escape detection. In addition, the blue light of these stars is dimmed considerably by the huge interstellar dust clouds. As a result, the true limit of the galactic system is still beyond our reach using the blue and white giant stars.

A new approach has been undertaken recently at the Warner and Swasey Observatory, of the Case Institute of Technology, through the study of red giant stars of type *M*. These stars have not been used much in the past because their predominantly red light does not register well on ordinary photographic emul-



A portion of a contact print (original scale) of a spectrum plate of a field in Cygnus, made with the Schmidt-type telescope of the Warner and Swasey Observatory, employing a 4-degree objective prism. The original field of view covers 23 square degrees. Exposure time was 30 minutes; the average number of M-type stars per square degree in this field is 110. The rectangle is shown enlarged on the opposite page.

sions. The development of fast red and infrared emulsions has made it possible to take full advantage of the enormous amount of radiation which these red stars emit.

Objective-prism spectra are taken with the Case Schmidt camera, which has a 24-inch correcting plate and a 36-inch mirror. The emulsion is Eastman I-N (ammonia hypersensitized) used with a Wratten No. 89 filter, which cuts out the unwanted blue light and reduces sky fogging to a minimum. With half-hour exposures and a 4-degree prism, the spectra extend from 6800 to 8700 angstroms, the region known as the near infrared.

The *M* stars are easily identified from the heavy absorption bands, due to molecules of titanium oxide, which can be detected easily even with very short spectra. As the red light of the *M* stars suffers much less absorption than does blue light, many spectra have been obtained for stars which are probably more than 30,000 light-years distant. Apparently no other method, with the exception of those which use rare objects such as the Cepheid variables, planetary nebulae, or novae, can reach these great distances within the galaxy.

The red giant stars are, however, far from rare. The number of *M* giants for which spectra can be obtained at the present time with the Case equipment is probably close to a million. This is shown from plates already taken in the galactic zone. Some of the stars are so faint and red that they fail to show their images on the longest direct exposures taken with the Case Schmidt on ordinary photographic emulsions.

It is significant that the number of *M* stars drops abruptly in photographs taken 10 degrees from the galactic plane. This not only reconfirms the flatness of the galactic system but indicates that we are able to reach the limits of the system by this method.

Co-workers on this project are Dr. J. J. Nassau, director of the Warner and Swasey Observatory, and Dr. G. B. van Albada.

An Unseen Companion

FIVE DEGREES APART in the constellation of Cassiopeia there are two faint red stars known to be moving together through space because they have common proper motions, parallaxes, and radial velocities. In 1923 one of these stars, BD +66°34, was found by Dr. A. N. Vyssotsky to be a visual double on plates taken with the 26-inch telescope of the Leander McCormick Observatory of the University of Virginia. The components of this double star seem to have a period of mutual revolution of from 250 to 300 years.

Dr. Harold L. Alden, also of McCormick Observatory, reported that from 91 plates of the region taken in the interval 1923-1947 it has been found that the primary of the double star revolves about the center of gravity of itself and an unseen companion in a period of 16 years. The distance between the components of the close pair is of the order of five astronomical units, and the probable mass of the unseen companion is 1/10 that of the sun. This is near the limit for a self-luminous body and the star is to be counted among the intrinsically faintest known. There are probably many of these faint objects in space, but their detection is difficult except in cases such as this where dynamical effects lead to their discovery.

The other star moving with BD +66°34 is BD +70°68b, and it may be considered as making the complete system quadruple.

Solar Limb Phenomena

TWO MICHIGAN ASTRONOMERS, Helen W. Dodson and E. Ruth Hedeman, are seeking to help interpret the great variety of activities seen on the limb or edge of the sun in terms of the more general solar surface features and phenomena. Their first step has been to set up a geometrical aid in determining the disk positions of the solar limb phenomena, notably of more-or-less stable prominences.

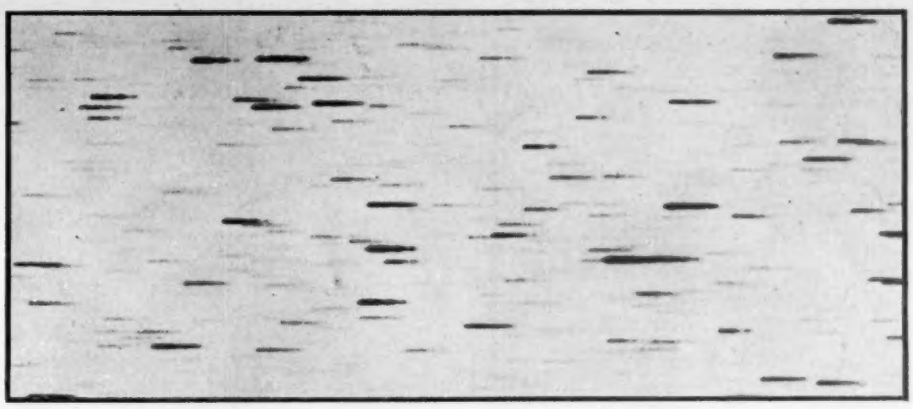
Members and guests of the American Astronomical Society, gathered on the steps of the [illegible]ort[illegible] 3-6, 1947. Photo by Evans[illegible] Ph

The disk position corresponding to a limb feature is usually quite uncertain since prominences of great heights can be observed very far from the solar limb. For prominences within 30 degrees of the limb, true heliographic latitude differs from observed latitude by less than five degrees. But the great uncertainty in disk position lies in meridian distance and hence in heliographic longitude. For example, a prominence observed to be 1/20 of the sun's radius in height, at latitude 40°, may be located anywhere within a range of 60 degrees of heliographic longitude depending on whether its true height is 1/20 or as much as 3/20 of the sun's radius. In the second case only one third of the prominence's total height would be visible beyond the edge of the sun, the rest being projected in front of or hidden behind the disk.

The methods proposed in this paper have proved successful in determining the heliographic co-ordinates of prominences recorded in some of the motion pictures taken with the tower telescope of the McMath-Hulbert Observatory. In each instance, several features of a semi-active prominence were identified with corresponding portions of a filament on the disk.

Distance of SS Cygni

AMONG VARIABLE STARS, those named after SS Cygni are of very great interest, for no explanation of their peculiar behavior is known at present. The SS Cygni stars remain at a minimum brightness with comparatively steady light for intervals ranging from about 20 to 150 days. At nearly periodic intervals they increase in brilliance, usually with great suddenness, and after a brief maximum of variable duration they decline to their original brightness.



The rectangle in the picture on page 14 is enlarged here somewhat more than three times. The breaks in the spectra are due to bands of titanium oxide and indicate M-type stars. With the 4-degree prism the original spectra are about 1.2 millimeters long in the spectral region 6800 to 8700 angstroms.

The distance of SS Cygni itself has been uncertain because at one time a negative parallax was secured for it. Its relatively high proper motion, and spectroscopic studies both indicated that it was rather near to us and therefore a dwarf star, as its normal minimum apparent magnitude is 12. Dr. K. Aa. Strand, newly appointed director at Dearborn Observatory, has measured a series of parallax plates taken in recent years with the 40-inch refractor of Yerkes Observatory.

The new determination gives a parallax of 0″.032, with a probable error of 0″.007. The distance is about 102 light-years. Thus the star has an absolute magnitude at minimum of about 9, several magnitudes fainter than the typical *G* dwarf star (such as the sun) which its spectrum resembles. During maximum light the spectrum is like that of an early *B* star, but here again it is intrinsically fainter by several magnitudes than the typical star of that type.

of the Northwestern Technological Institute for the 77th meeting of the society, September Evans Photographic Service.

Nova of 1912 Studied

NEW STARS still present many mysteries to astronomers. The greatest information concerning what happens when a nova bursts into brilliance and then fades is found from the extremely rapid changes in its spectrum. If, at any one observatory, clouds intervene during the crucial days following a nova's maximum, spectra from elsewhere must be obtained to give a continuous record.

In the case of Nova Geminorum 1912, a star which reached the 3rd magnitude, the observations taken at each of several observatories contained serious gaps due to bad weather, and corresponding uncertainties in the interpretation of spectral changes resulted. Dr. Dean B. McLaughlin, of the Observatory of the University of Michigan, has collected 65 slit spectrograms of Nova Geminorum taken at six observatories: Allegheny, Lick, Lowell, Michigan, Mount Wilson, and Yerkes. The resulting record is complete for 23 consecutive days, from March 13th to April 5th, 1912, except for March 14th. Fortunately, objective-prism spectra taken at Harvard on March 13th and 14th, while not suitable for quantitative measures, give assurance that no important changes in spectral features were missed. The 23 days are the period during which the various sets of dark lines were strongest.

Contrary to the conclusions of earlier investigators of this star, who had worked with incomplete sequences of spectra, Dr. McLaughlin found that the various typical nova absorption systems and sub-systems remained permanently separate. Some supposed cases in which a line split into two lines and then merged again are not confirmed by his work. As similar results have been obtained by the Michigan astronomer and by others for several other novae, the need for a really continuous series of observations of any new star is especially emphasized.

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BOOKS AND THE SKY

EINSTEIN, HIS LIFE AND TIMES

Philipp Frank. Alfred A. Knopf, New York, 1947. 298 pages. $4.50.

IN THIS VALUABLE and readable book, Professor Frank builds up a comprehensive description of Einstein as a man, as a physicist — probably the greatest since Newton — and as a public figure. He is able to do this with insight and authority because he himself is a great and scholarly physicist, and because his own career has somewhat paralleled that of Einstein. Thus he exhibits a sympathetic understanding of the tremendous problems Einstein has had to face. Much of the record is from firsthand knowledge.

Intimate glimpses obtained during frequent close association indicate Einstein's charming but complex personality. His attitude toward social problems has been detached, conscientious, and somewhat naive. The development of his views on pacifism and Zionism is outlined; he was sometimes puzzled and saddened but never embittered by unjust attacks on him by zealots, not all of whom were ignorant. One admires Frank's objective and restrained discussion of the emotional, racial, and nationalistic movements which bore so heavily on Einstein. Many curious manifestations of anti-Semitism are cited, and the Nazi attitude toward science is partially explained. There is a graphic account of Einstein's political difficulties in Germany, which includes a description of the general methods of Hitler's purge.

Chapter VI should give the thoughtful reader some comprehension of the underlying meaning of the general theory of relativity — Einstein's original but simple and straightforward approach to the problem of the motion of a body under gravitational forces. His approach was unusual, but that is about all that can be said against it. It may be thought of as replacing two concepts by one. The replaced concepts are: 1. The idea of mass which can be determined in numerical units; we ordinarily do this by weighing the body, that is, by measuring the force acting on it in the earth's gravitational field. 2. The assumption that the measured force is an independent physical entity which acts on all bodies in proportion to their mass. On due consideration these two concepts seem to be a hard way of indicating that in a given gravitational field (one which the test bodies themselves do not modify) all bodies of whatever mass exhibit the same motion. This is the hypothesis implicit in Einstein's approach in which the familiar concepts of force and acceleration are omitted, their place being taken by a geometrical theory.

Frank gives a stimulating discussion of the types of explanations of physical phenomena which have prevailed at various epochs. He compares the transition from the "organismic" physics of ancient and medieval times to the "mechanistic" physics of Newton with the recent transition (for which Einstein is the symbol) from the "mechanistic" to the "mathematical" description of nature. Haldane has said, " . . . what Newton was to the eighteenth century, Einstein is for the twentieth."

Discussions of the interaction between science and philosophy occur at several points in the book. Frank cites situations which illustrate the importance of rhetorical values in the interpretation of physical theories by philosophers as well as by politicians and the public at large.

Einstein possesses the ability to compress complex ideas in brief, pithy statements. One of these was chosen as the motto of the book: "The most incomprehensible thing about the world is that it is comprehensible." Another is Einstein's remark about certain "empiricists" in physics: "Everything that they learned up to the age of eighteen is believed to be experience. Whatever they hear about later is theory and speculation." Certain aspects of the quantum theory he once thought to be heuristic: "I shall never believe that God plays dice with the world." On another occasion he remarked, "God is sophisticated, but He is not malicious."

I recommend the book highly to all thoughtful readers of **Sky and Telescope.**

PAUL W. MERRILL
Mount Wilson Observatory

NEW BOOKS RECEIVED

ONE TWO THREE . . . INFINITY, *George Gamow*, 1947, *Viking*. 340 pages. $4.75.

Facts and speculations of science, by the author of *The Birth and Death of the Sun* and *Biography of the Earth.*

MANUAL OF ASTRONOMY, *Shaw* and *Boothroyd*, 1947, *Crofts*. 294 pages and charts. $3.00.

The third edition of a manual of elementary astronomical practice and procedure which has grown considerably in scope and presentation since the first edition in 1941.

THE NAMING OF THE TELESCOPE, *Edward Rosen*, 1947, *Schuman*. 110 pages. $2.50.

An authoritative work which brings to light many little-known facts and events concerning the early days of the most important of astronomical instruments. It contains a number of reproductions of original writings which make it invaluable as a reference book.

SUNSPOTS IN ACTION, *Harlan True Stetson*, 1947, *Ronald*. 252 pages. $3.50.

An account in popular style of our present-day knowledge and of some of the problems connected with the sun's activity and solar-terrestrial relations.

ASTRONOMY, *Skilling* and *Richardson*, 1947, *Holt*. 692 pages and charts. $4.75.

A second edition of this elementary textbook includes many of the new astronomical developments since the 1939 edition was published.

ATOMS, ROCKETS, AND THE MOON, *Dinsmore Alter*, 1947, *Griffith Observatory*. 44 pages. 65c.

This well-printed and illustrated booklet (size 8 x 10½ inches) is written as part of the program of the Griffith Observatory and Planetarium to bring the facts of physical science to the public in an elementary but dramatic way, without loss of scientific accuracy. There are eight chapters, entitled: The Setting; Outline of the History of Atomic Knowledge; The Cyclotron; Automatic Disintegration of Atoms; Peacetime Uses of Atomic Power; To the Moon?; Living on the Moon; Space Travel Fantasy.

Included among the clear and illuminating diagrams and photographs is a picture of the atomic bomb test at Bikini, and a view of the earth from a V-2 rocket 100 miles high. A table of atomic elements through No. 96 gives atomic number, name, symbol, atomic weight, and the number of naturally occurring isotopes.

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COMPLETE OPTICS & METAL PARTS—Model M-13A1, 6 x 30 Binoculars. Everything you need — ready for assembly. When finished will look like a regular factory job costing $102 to $120. The Optics are new, in perfect or near perfect condition. Have new low reflection coating. Metal Parts are new and perfect, all completely finished. No machining required. Bodies factory hinged and covered. Complete assembly instructions included.
Stock #830-Y ..... **$40.00 Postpaid, plus $8.00 tax** ..... **Total, $48.00**

COMPLETE OPTICS & METAL PARTS—Model M-3, 6 x 30 Binoculars. The Optics in this set are new, perfect or near-perfect. Prisms have new low reflection coating. Factory mounted Eye Piece and Objective Assemblies not coated. Metal Parts are perfect, new, ready for assembly. When finished, this will look like a regular factory job, except a name has been filed off a cover plate. No machining required. Bodies factory hinged and covered.
Stock #831-Y ..... **$35.00 Postpaid, plus $7.00 tax,** ..... **Total, $42.00**

METAL PARTS ONLY—Model M-13A1, 6 x 30 Binoculars. No Optics. Same Metal Parts as described for Stock #830-Y.
Stock #832-Y, 6x30 Metal Parts, $25.00 Postpaid

OPTICS FOR 6 x 30 BINOCULARS (No Metal Parts.) Perfect, and low reflection coated.
Stock #5130-Y ..... **$15.00 Postpaid**

SAME OPTICS AS ABOVE—Coated—but slight seconds.
Stock #5124-Y ..... **$12.75 Postpaid**

If you buy both the Binocular Optics and the Binocular Metal Parts, your purchase becomes subject to 20% Federal Excise Tax. Be sure to add amount covering tax to your remittance or your order cannot be filled.

Optics and Metal Parts are Available for Monoculars (¼ a Binocular). For Complete Details, Write for Bulletin #14-Y.

Stock #1-Y — "Our Advertising Special" — 15 lenses for $1.60 Postpaid, plus 10-page idea booklet. For copying, ULTRA CLOSE-UP SHOTS macrophotography, experimental optics, magnifying and for making a two power f/16 Telephoto Lens, "Dummy Camera," Kodachrome Viewer, DETACHABLE REFLEX VIEW-FINDER for 35 mm. cameras, stereoscopic viewers, ground glass and enlarging focusing aids, TELESCOPES, low power Microscopes and for many other uses.

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3 power instrument, brand new, with plastics Optics and fixed focus. 23" long. Wt. 31 lbs. Wide field of view.
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(Shipping Wt. about 70 lbs.)

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With Polarizing Variable Density Attachment Can be used as Slide Viewer, or take it apart and you can get Polarizing Variable Density Attachment, Mangin Concave Mirror, Reflector Plate, Metal Reticle, Window, Lamp Housing, Ring and Bead Sight. The Polarizing attachment alone is worth many times the price of entire unit. Consists of 2 Polarizing Filters mounted with small handle which rotates one around the other. May be used in Photography, Research, Experiments, as Light Dimmer, etc.
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F.L. 91.44 mm. (just right for 35 mm. Projectors). Speed of F.1.9. Outside dia. of mount at one end 60 mm. Length of mount 64 mm.
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MOUNT FOR ABOVE PROJECTION LENS SYSTEM — Stock #715-Y ..... **$1.50 Postpaid**

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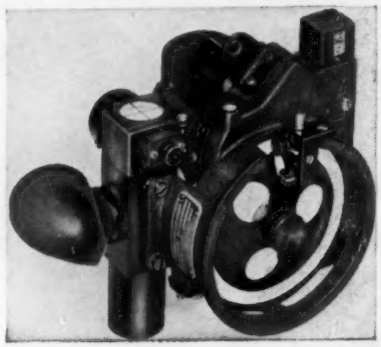

These Army Air Forces Bubble Sextants cost the Govt. about $125 each. A real bargain at our price of $12.50! Included with Bubble Sextant shipment is wooden Carrying Case, 5 spare waxed paper discs, flashlight with rheostat for night use (uses ordinary flashlight cells—not furnished) aux. 2-power Galilean Telescope, Allen wrench, 1 spare marking point. Wartime used, but where necessary completely repaired, collimated and put in good working order. Light bulb has been tested—Bubble is in working condition. Because of wartime use, we make this guarantee: if not satisfied that Sextant is exactly as represented, return within 10 days and money will be refunded. Full directions for use accompany each shipment.
Stock #924-Y ..... **$12.50 Postpaid**
Same SEXTANT as above, but new and with Automatic Electric Averaging Device and illuminated Averaging Disc for nighttime use. Govt. cost $217. We have checked Bubble and Collimation and guarantee perfect working order.
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CONDENSING LENSES—Seconds, but suitable for Enlargers and Spotlights.
Stock #1061-Y 6½" dia., 9" F.L. $2.50 Postpaid
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We Have a Limited Quantity of Condensing Lenses —seconds—ranging from 4½" to 8½" in dia. with various focal lengths. Send for Free Bulletin titled **"MISCELLANEOUS CONDENSING LENSES-Y."**

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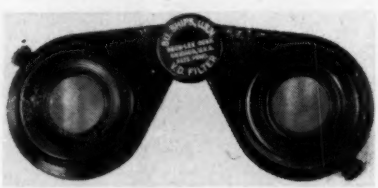

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These sets contain all Lenses and Prisms you need to make a Spectroscope plus FREE 15-page Instruction Booklet.
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An exceptional opportunity to secure a large variety of Optical Pieces both Crown and Flint glass (seconds) in varying stages of processing. Many prism blanks.
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SPRINGFIELD MOUNTINGS BY AMATEURS

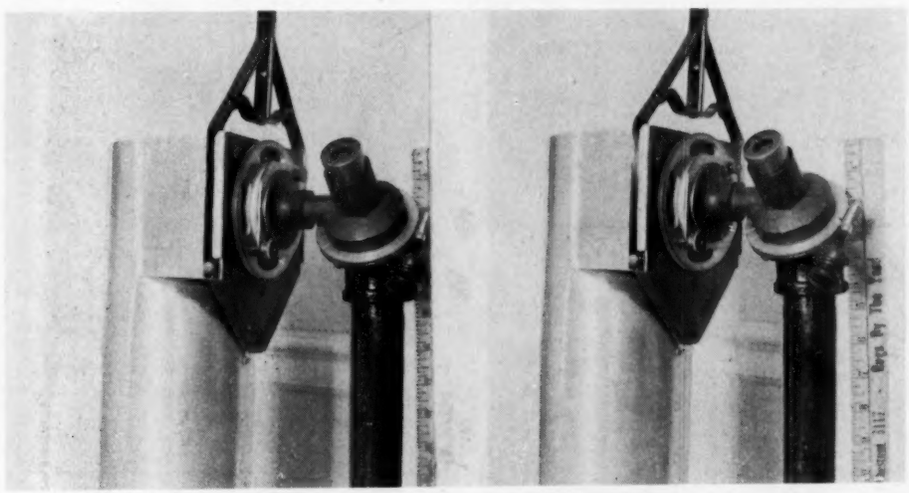
THE JANUARY, 1947, ARTICLE on Springfield mountings brought several reports from ATM's who have constructed examples of this type of mechanism for themselves. We reproduce herewith photographs and brief descriptions of two of these.

Edward W. Allen, Jr., of 3225 S. Sixth St., Arlington, Va., has taken stereo photographs of his mounting, which are the first stereos we have had the opportunity to publish in Gleanings. We wish we might have more, as there is no better way of showing the details of a mechanical device. In connection with the construction of this instrument, Mr. Allen writes:

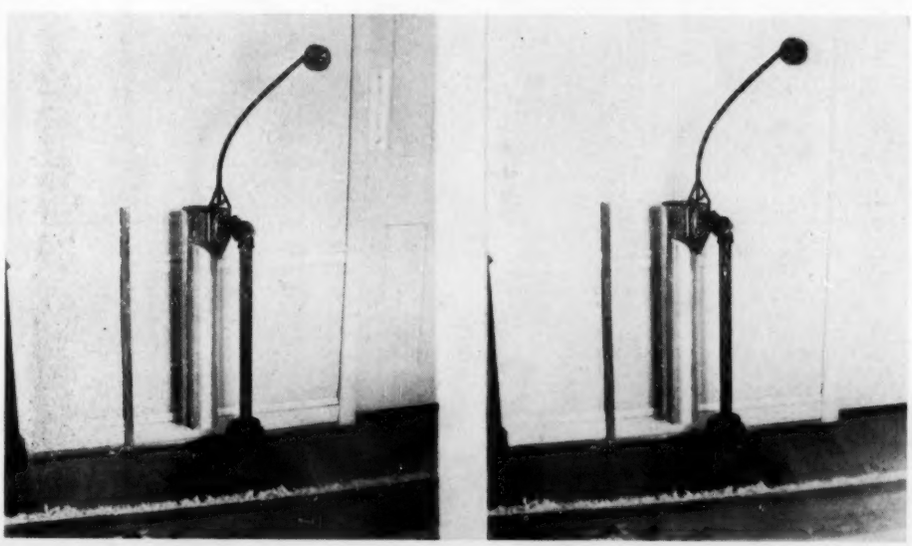
"My Springfield has a tube 6" in diameter, 28" long, made of 0.025" aluminum sheet riveted at 1½" intervals by aluminum rivets. The upper end of the tube is split to form straight sides which fasten to a hardwood board and which are then bent backward to form channels to support the bracket for the counterweight. The board is also fastened by two screws through the overlapping seam of the tube. The counterweight bracket is of ¼" x ¾" steel, bent parallel to the longer dimension and having a truss of ⅛" x ⅝" steel at the bottom. The counterweight consists of eight steel disks and locates the center of gravity within the bearing of the polar axis.

"The mount consists of a 2" pipe with a 45° elbow at the top and a flange at the bottom, fastened by four screws to the hardwood base. The elbow is machined to form a socket for the turret, the axis of the socket being 39° from the horizontal, the latitude of Washington, D. C. The use of a wye instead of an elbow is recommended because of the difficulty of chucking an elbow in a lathe together with the possibility of obtaining a longer and steadier bearing for the polar axis. A shoulder with a reversed taper is machined on the outside of the elbow to receive a steel disk 0.2" thick and 3.4" diameter, shrunk on. The disk furnishes additional bearing surface and acts as a support for the slow-motion knob and worm assembly.

"A brass steam trap is machined to form the turret. The part of the trap which formerly housed the bellows is made to fit the socket in the elbow. The pipe opening of the trap in line with the socket is machined to receive the eyepiece and an extension tube. The opening at right



Stereo pictures of Edward Allen's Springfield telescope. The three-dimensional effect may be obtained as follows: Hold the page about 10 to 12 inches from the eyes and concentrate on a spot midway between the two pictures, then try to project this spot, visually, to infinity. When seeing stereoscopically, the lines of fixation of the two eyes are parallel, the left eye directed at the left picture and the right eye at the right picture. With a stereo viewer, the use of the pictures is simple, but the viewer is not essential.



EYE PIECE—KELLNER'S, brand new, E.F.L. 27mm. (1 1/16 inch). Coated optics. Focusing mount with plus & minus 4 diopter scale. Clear aperture eye lens 19/32 inch. 1¼ inch O.D. across threads at objective end. This is a beautiful job you will be proud of in both appearance and performance.

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Stock # 20 ..... $3.75 ea.

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Stock # 21 ..... $5.00 ea.

EYE PIECE—Large, from aircraft sighting station. In 2⅞ inch dia. threaded aluminum mount with locking ring. E.F.L. approx. 2 inches. Coated optics, clear aperture eye lens over 1¾ inches.

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Lenses only for above.

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23 mm Dia.	184 mm F.L.	coated	ea.	1.35
25 mm Dia.	122 mm F.L.	coated	ea.	1.25
26 mm Dia.	104 mm F.L.	coated	ea.	1.25
29 mm Dia.	54 mm F.L.	coated	ea.	1.25
29 mm Dia.	76 mm F.L.	coated	ea.	1.25
31 mm Dia.	124 mm F.L.	coated	ea.	1.50
31 mm Dia.	172 mm F.L.	coated	ea.	1.25
32 mm Dia.	132 mm F.L.		ea.	1.50
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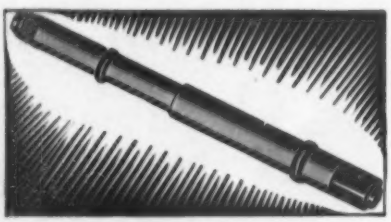

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ACHROMATIC OBJECTIVE—Perfect. Coated and cemented. 44 mm Dia. 7½" F.L. Unmounted .. ea. **$2.50** Mounted .. ea. **$3.50**

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angles thereto is turned on the inside to increase the aperture. The male threads of the latter were rerun in order to make the declination axis normal to the polar axis. The gear opening is machined to proper size and is clamped between the upper and lower parts of the turret; these parts are threaded together. The gear is of brass 3½" diameter, so as to extend beyond the steel plate on which it bears. It has 144 teeth and is engraved with 24 hour-angle markers. Each hour thus corresponds to six teeth, or each tooth to 10 minutes. A 10-point dial on the worm assembly permits adjustment of the polar axis to the nearest minute. The worm assembly bearing is pivoted so the worm can be disengaged from the gear for rapid rotation of the telescope on the polar axis.

"The bearing for the declination axis is a brass hexagonal pipe coupling, the outer end of which is turned to form a cylindrical bearing and a seat for the conical disk which is pressed onto it. The outer face of the disk is machined to form a disk bearing, and a shoulder is cut into the inner edge to receive the clamping ring. The heavy 4" brass gear is machined on the face and within the hub to form bearing surfaces with the coupling and disk, and is fastened to the board by four machine screws, two of which extend through holes in the clamping ring and are provided with knurled nuts for tightening the ring.

"The mirror is of 4¼" diameter, 34

SKY-GAZERS EXCHANGE

Classified advertisements for this column are 8 cents a word, minimum ad 20 words. Remittance must accompany orders. Address Ad Dept., Sky and Telescope, Harvard Observatory, Cambridge 38, Mass.

WANTED: War surplus 24" focal length 5" objective, and 4½" objective. Pay cash. For trade 7 x 50 binoculars, 8 x 40 Zeiss field glasses. Box 481, Salem, Mo.

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EYEPIECES: achromatic, coated, wide angle, 1.1" focal length, 1¼" diameter, $5.00. Leroy Benfer, 6130 Montrose Rd., Cheverly, Md.

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SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Sundays, 2:30 and 3:30 p.m.

STAFF: *Director,* Wagner Schlesinger. *Other lecturer:* Harry S. Everett.

November: LIGHTHOUSES OF THE SKY. The methods by which time and the observer's position on the earth can be determined from the appearance of the sky will be explained.

December: THE STAR OF BETHLEHEM.

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SCHEDULE: Mondays through Saturdays, 3 and 8:30 p.m.; Sundays and holidays, 3, 4, and 8:30 p.m.

STAFF: *Director,* Arthur L. Draper. *Other lecturers:* Nicholas E. Wagman, J. Frederick Kunze.

November: SONG OF THE EARTH. How poets have written of our planet, from ancient times to modern. And STARS OVER PITTSBURGH. A 60-minute refresher course in the winter constellations.

December: STAR OF BETHLEHEM.

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SCHEDULE: 3 and 8:30 p.m. daily except Mondays; also 2 p.m. on Saturdays, Sundays, and holidays. 11 a.m. Saturdays, Children's Hour (adults admitted).

STAFF: *Director,* Roy K. Marshall. *Other lecturers:* I. M. Levitt, William L. Fisher, Armand N. Spitz, Robert W. Neathery.

November: STAR RAINBOWS. The elements of astrophysics will be presented in a way that will permit all to understand the astronomer's methods of gaining knowledge about the distant objects in space.

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STAFF: *Director,* Dinsmore Alter. *Other lecturers:* C. H. Cleminshaw, George W. Bunton.

November: ECLIPSES. The partial eclipse of the sun on November 12th makes the explanation and reproduction of different kinds of eclipses of current interest.

December: THE STARS OF WINTER.

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STAFF: *Honorary Curator,* Clyde Fisher. *Chairman and Curator,* Gordon A. Atwater. *Other lecturers:* Robert R. Coles, Catharine E. Barry, Shirley I. Gale, Edward H. Preston.

November: THE STAR THAT MAKES THE WEATHER. Our sun might be the agent that manufactures our weather, and it is surely the star that supports earthly life. What is it made of? How is its energy sent to us?

December: THE STORY OF CHRISTMAS.

inches focus, aluminized. It is supported by four spring fingers with sponge-rubber linings, fastened with two screws each within the lower end of the tube. The diagonal within the tube is a first-surface aluminized mirror supported on a sheet aluminum mount fastened to the board. A prism diagonal is mounted within the turret, receiving light from the diagonal mirror through the hollow declination axis."

C. M. Ginter, 6458 Brann St., Oakland, Calif., a member of the Eastbay Astronomical Association, sends the photograph which we reproduce here, and writes:

"My first mounting was patterned after one illustrated in **Amateur Telescope Making,** but I did not like it, and studied the sketches by Porter in the same book in hope of being able to improve upon it. My final result is a modification made to Porter's idea in the interest of economy.

"The right-angle bracket is made of ⅜" boiler plate, bent at right angles by a blacksmith, and having two tubular braces welded to it for additional strength. The counterweight is made from a discarded exhaust valve casting, filled with babbitt. The tripod is of welded steel pipe, with an angle at the top to provide attachment of the polar axis by means of a union. This makes the telescope easily removable from the tripod for storing. I am planning to replace the tripod in the near future with a wooden one, for portability.

"The finder is a World War I periscope, the upper prism having been used in the telescope and the remainder of the periscope converted into a straight instrument by the addition of a short extension.

C. M. Ginter and his Springfield.

"One of the most important advantages of this form of mounting as I see it is that the telescope is not thrown out of focus when the eyepiece is being changed. Furthermore, having passed my 76th birthday, I don't care to exert myself any more than I have to, and this mounting allows me to view any part of the heavens from one position.

"The total cost of this telescope did not exceed 50 dollars."

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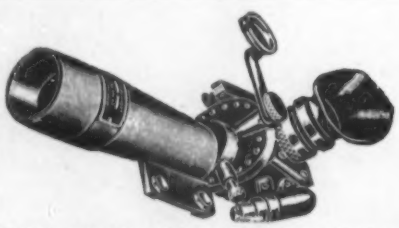

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OBSERVER'S PAGE

Greenwich civil time is used unless otherwise noted.

THE ECLIPSE OF NOVEMBER 12th

The second solar eclipse of 1947, this one annular, may be seen in partial phases in most of the United States. The path of the annular eclipse is across the eastern Pacific Ocean to South America, as shown in the accompanying map from the **American Ephemeris.**

In the northeastern states only a small portion of the solar disk will be obscured; the West Coast will see a larger area covered. Below is a brief summary for several cities showing times of mid-eclipse and magnitudes of the eclipse. A complete table of circumstances may be found in the **Ephemeris.**

City	Standard time of mid-eclipse	Per cent of sun's diameter obscured
Atlanta, Ga.	2:43 p.m.	10
Austin, Tex.	2:16 p.m.	20
Berkeley, Calif.	11:05 a.m.	39
Boise, Idaho	12:14 p.m.	22
Cambridge, Mass.	3:48 p.m.	1
Cincinnati, Ohio	2:34 p.m.	3
Denver, Colo.	12:42 p.m.	14
Evanston, Ill.	2:21 p.m.	1
Flagstaff, Ariz.	12:30 p.m.	28
New Orleans, La.	2:38 p.m.	17
New York, N. Y.	3:48 p.m.	2
Pasadena, Calif.	11:15 a.m.	39
St. Louis, Mo.	2:22 p.m.	5
Seattle, Wash.	11:03 a.m.	24
Washington, D. C.	3:47 p.m.	4

A word of caution. It is dangerous to view the sun unless proper precautions are taken. A heavily smoked glass will suffice for the naked eye, with which partial phases down to two or three per cent may be seen. An excellent method of observing the sun with a telescope is to project the image on heavy white paper, thus giving more than one person a view. Where larger portions of the sun are obscured, the lunar disk may come in contact with sunspots, making excellent subjects for photography.

EDWARD ORAVEC

MIRA AT MAXIMUM

Last year the maximum magnitude of Omicron Ceti was 4.0, whereas on October 6, 1947, Leon Campbell, recorder of the AAVSO, observed this long-period variable at a magnitude of 3.0. As Alpha Ceti is 2.8, Mira was then second brightest star in the constellation. It is well placed for observation in the evening sky, but its decline in brightness will probably set in by the time this note is published. For comparison, Gamma Ceti is magnitude 3.7.

Dr. Dean B. McLaughlin, of the University of Michigan Observatory, found on a spectrogram of Mira taken September 23rd that the emission line of hydrogen beta was unusually strong, which suggests that the current maximum should be especially bright. This is in agreement with Mr. Campbell's findings that the shorter the time interval from magnitude 6.0 on the rise to maximum to 6.0 on the next rise, the brighter the next maximum. The present interval is slightly shorter than the average 330-day period of the variable.

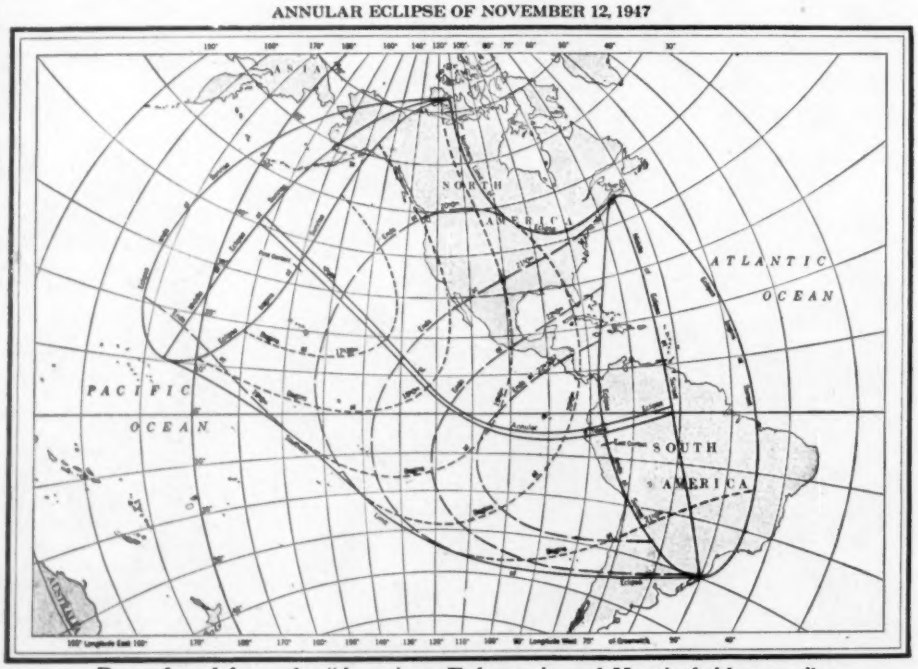
PHASES OF THE MOON

Last quarter	November	5, 17:03
New moon	November	12, 20:01
First quarter	November	20, 21:44
Full moon	November	28, 8:45
Last quarter	December	5, 0:55

MINIMA OF ALGOL

November 2, 10:57; 5, 7:46; 8, 4:35; 11, 1:23; 13, 22:12; 16, 19:01; 19, 15:50; 22, 12:39; 25, 9:28; 28, 6:17. December 1, 3:06; 3, 23:55.

ANNULAR ECLIPSE OF NOVEMBER 12, 1947



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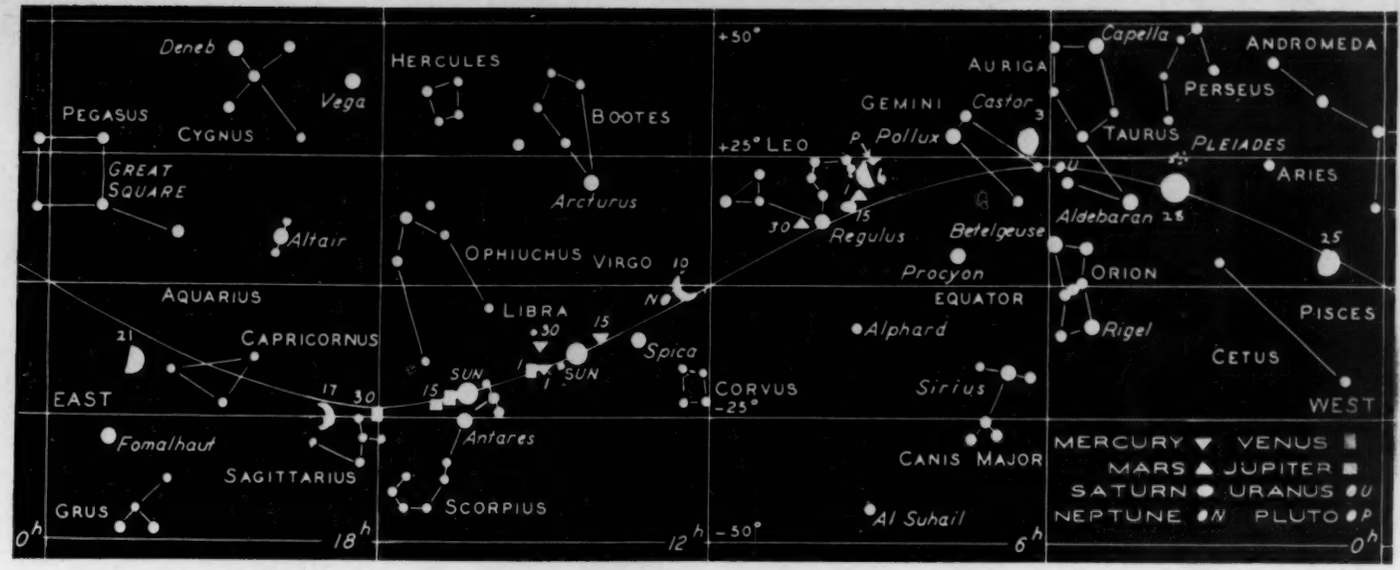

THE SUN, MOON, AND PLANETS THIS MONTH

The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.

Mercury passes inferior conjunction with the sun on November 5th, moving into the morning sky. Then it rapidly reaches greatest elongation on the 22nd, 19° 44′ west of the sun. The elusive planet may be found about the 15th and followed till the first week in December. At elongation, Mercury will rise 1½ hours before the sun and will be −0.3 magnitude.

Venus is visible shortly after sunset low in the southwestern sky. It sets an hour after the sun, and remains at magnitude −3.3. The swift movement of Venus brings the planet into four constellations through November: Libra, Scorpius, Ophiuchus, and Sagittarius.

Mars rises at about 11 o'clock local time, and is at quadrature, or 90° west of the sun, on the 17th. Three bright objects, Saturn, the star Regulus, and Mars, will form interesting configurations this month. The first week of November, Mars will lead the procession across the sky, with Saturn close behind, and Regulus 10° farther to the east. On the 11th, Mars passes Saturn, less than a degree north. They have nearly equal magnitudes, Saturn +0.7, and Mars +0.9. By November 20th Mars will be equidistant between Saturn and Regulus, and on the 27th the planet passes 2° north of Regulus.

Jupiter may be glimpsed early in November close to the sun in the evening sky. Venus will pass a degree to the south on the 9th. After sunset on the 13th, the day-old crescent moon will appear nearly 2° below Jupiter, and with Venus 3° away will form a small triangle entirely visible in field glasses. Jupiter will be in conjunction with the sun on December 1st.

Saturn is located in Leo. For configurations this month, see the notes on Mars.

Uranus, in Taurus, may be seen with slight optical aid most of the night. It is moving westward in retrograde motion, and on the 15th is at 5h 40m, +23° 30′ (1947).

Neptune remains too close to the sun in the morning sky to be found this month.

EDWARD ORAVEC

GREENWICH CIVIL TIME (GCT)

TIMES used on the Observer's Page are Greenwich civil or universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the GCT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown.

METEORS

Mid-November brings us to the time of the Leonid meteors. Perturbations from the major planets have apparently moved the orbit of the main stream away from the earth's orbit, so all that remains of the shower each year are a few stragglers.

After midnight on the nights of November 13th to 16th, we may see up to 20 meteors per hour radiating from near the star Gamma Leonis. The shower meteors may be seen in the entire sky but when the paths are traced back they will intersect near Gamma. The Leonids are very swift meteors, often leaving trains or streaks on the sky.

E. O.

VARIABLE STAR MAXIMA

November 5, R Phoenicis, 7.8, 235**150**; 9, X Monocerotis, 7.6, 065**208**; 16, U Ceti, 7.5, 022**813**; 16, T Normae, 7.4, 153**654**; 18, R Reticuli, 7.7, 043**263**; 30, RS Scorpii, 6.8, 164**844**. December 1, T Cassiopeiae, 7.8, 001755; 1, RV Centauri, 7.6, 133**155**; 3, RU Sagittarii, 7.2, 195**142**.

These predictions of variable star maxima are made by Leon Campbell, recorder of the AAVSO, Harvard College Observatory, Cambridge 38, Mass. Serious-minded observers interested in making regular telescopic observations of variable stars may write to Mr. Campbell for further information.

Only stars are included here whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0. Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

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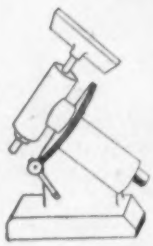

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November 1-2 **118 Tauri f** 5.9, 5:26.0 +25-06.6, 19, Em: **A** 3:56.9 −0.3 −2.3 225; **B** 4:03.0 −0.4 +2.1 234; **C** 3:48.0 −0.1 +2.2 223; **D** 3:57.1 −0.3 +1.9 238; **E** 3:48.2 −0.1 +1.6 246; **F** 3:32.8 +0.3 +1.6 234; **G** 3:59.7 −0.1 +1.1 292; **I** 3:58.1 0.0 +0.8 300.

1-2 **BD +25° 879** 6.3, 5:33.2 +25-54.4, 19, Em: **A** 7:47.3 −2.2 −2.3 308; **B** 7:33.8 ... ... 329; **C** 7:42.5 −2.3 −1.2 295; **D** 7:26.7 ... ... 323; **E** 7:03.7 −3.5 −3.8 323; **F** 6:57.3 −2.2 −0.1 289.

1-2 **125 Tauri** 5.0, 5:36.4 +25-52.2, 19, Em: **A** 9:40.9 −1.5 −1.1 277; **B** 9:35.4 −1.5 −1.5 288; **C** 9:35.8 −1.8 −0.3 263; **D** 9:28.5 −1.7 −1.0 280; **E** 9:08.4 −2.0 0.0 268; **F** 8:45.0 −2.0 +1.8 237; **H** 8:10.2 −1.8 +0.3 286.

3-4 **c Geminorum** 5.4, 7:40.9 +25-54.7, 21, Em: **A** 7:06.5 −1.8 −1.4 320; **B** 6:58.0 ... ... 339; **C** 7:02.0 −1.7 −0.6 308; **D** 6:51.3 ... ... 335; **E** 6:36.0 −2.1 −2.7 337; **F** 6:35.2 −1.0 −0.1 302.

19-20 **35 Capricorni** 6.0, 21:24.2 −21-25.6, 6, Im: **A** 0:09.1 −1.4 −0.2 66; **B** 0:07.2 −1.3 −0.1 58; **C** 0:02.4 −1.7 0.0 66; **D** 23:59.3 −1.4 +0.3 53; **E** 23:39.8 −1.6 +1.1 42; **F** 23:12.9 −2.3 +1.5 51.

24-25 **Mu Piscium** 5.1, 1:27.4 +5-52.3, 12, Im: **B** 7:33.1 −0.2 −0.8 71; **D** 7:33.0 −0.4 −1.0 77; **E** 7:30.4 −0.8 −1.3 89; **G** 7:05.8 −0.8 +0.8 34; **H** 6:51.2 −1.9 0.0 73; **I** 6:57.0 −0.8 +1.4 28.

December 3-4 **46 Leonis** 5.7, 10:29.4 +14-24.6, 21, Em: **A** 10:58.5 −2.3 +0.1 263; **B** 10:55.6 −2.0 −0.2 270; **C** 10:39.6 ... ... 234; **D** 10:42.0 −2.6 +1.1 253; **G** 9:53.0 −1.0 +2.6 248; **I** 9:41.4 −0.6 +3.1 241.

For selected occultations (visible at three or more stations in the U. S. and Canada under fairly favorable conditions), these predictions give: evening-morning date, star name, magnitude, right ascension in hours and minutes and declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, GCT, a and b quantities in minutes, position angle; the same data for each standard station westward.

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A	+72°.5, +42°.5	**E**	+91°.0, +40°.0
B	+73°.6, +45°.6	**F**	+98°.0, +30°.0
C	+77°.1, +38°.9	**G**	+114°.0, +50°.9
D	+79°.4, +43°.7	**H**	+120°.0, +36°.0

I +123°.1, +49°.5

The a and b quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude respectively, enabling computation of fairly accurate times for one's local station (long. Lo, lat. L) within 200 or 300 miles of a standard station (long. LoS, lat. LS). Multiply a by the difference in longitude (Lo — LoS), and multiply b by the difference in latitude (L — LS), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Greenwich civil time to your own standard time.

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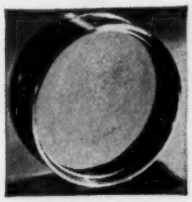

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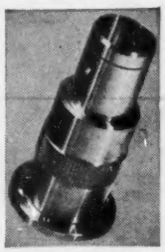

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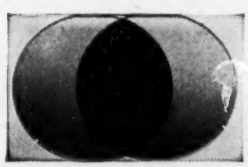

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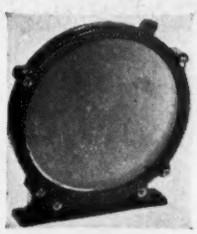

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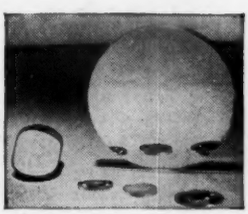

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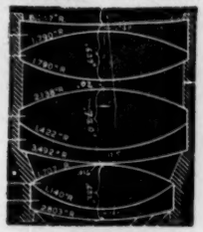

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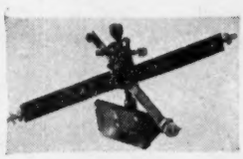
All outside surfaces fluoride coated. 2½" (64 mm) f.l., mounting O. D. 1-3/16" (30 mm), clear aperture ⅞" (23 mm). Suitable for inverter with our eyepiece; as an excellent corrected magnifier (4 power) and as a projection lens for 2x2" slides. **Each $3.50.**

Achromatic Loupe

1" f.l. (10x), ⅝" diameter, ½" thick. Made by American Optical Co. to Hastings formula. Spherically and chromatically corrected like the finest microscope lens. Remarkable for wide, flat field, brilliant image, greater working distance. Unmounted **$6.00.** Mounted in aluminum, **$7.50.**

Diagonal For Reflecting Telescope

4 ARM



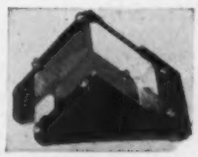
Prism in metal spider mount to fit 5-6-7 or 8" tube. Light flint glass prism, fluoride coated, 1¼" x 1¼" face. Connecting arms present thin edges to path of light. Prism centering easily adjusted to slight differences of tube diameter by lock washers. Complete, **$10.00** plus postage. Specify your tube size.

Front Aluminized Mirror

Finest quality plate ground to ¼ wave flatness and aluminized with a hard, almost scratch-proof coating. Nothing finer for use as a diagonal in place of prism. These "Flats" can also be used to reflect ultraviolet and infra-red light with minimum loss. Great saving if used in place of prisms in Porro #2 system.

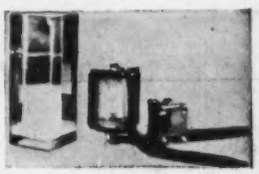
Size 2⅜" by 3¼" thick, **$2.00.**

Prism—Light Flint Glass



Fluoride coated, in mounting of aluminum-magnesium alloy, with ballbearing swivel. Meets most exacting requirements. 1-5/16" by 1¼" face. Suitable as diagonal for reflectors up to 8", also as star diagonal on refractors. These prisms can be used to make Porro's system #2 erector. **Price $3.75.**

PRISMS



Water-white crown glass of excellent quality. Government inspected and accepted. No chips or roughs. 45-90-45 degrees in mounts. Sizes:

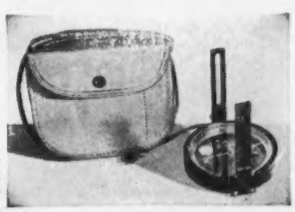
⅞" x ⅞" (23mm.) ..... @ **.75**
1⅝" x 1-3/16" ..... @ **$1.50**

Back silvered unmounted, size:
4" (102mm.) x 1½" (39mm.) ... @ **$3.00**

Star Diagonal

Fits standard 1¼" tube, takes 1¼" eyepiece. Precision quality throughout. Prism is fine quality fluoride coated. Finished in brass and black. Makes for convenient overhead viewing of stars with refractor. **$12.00.**

Compass and Alidade



Made by A. Lietz of San Francisco for hunters, engineers and surveyors for leveling, laying out land, mapping, ship and shore use. **$16.00.**

Prismatic Compass

Brilliant card pivoted on sapphire jewel bearing in bronze housing. Magnifying prism for aligning compass card and line-of-sight index for accurate bearings. Complete in leather case. **$5.00.**

FREE with any purchase from this ad amounting to $25.00 or more a cloth-bound copy of Allyn J. Thompson's new and popular 211-page volume — "Making Your Own Telescope." A profusely illustrated guide to the practical and economical construction of a reflecting type astronomical telescope.

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DEEP-SKY WONDERS

ROUGHLY, by theory, the ability to see nebulae should be a function of the f/ratio of the telescope. However, there is plenty of evidence to show that many faint objects are seen only in very small or very large scopes, utterly out of reach of intermediate sizes. Herschel, with his large diameter, long focal ratio, and poor reflecting surface, plotted many nebulae which today are difficult for the amateur. The objects listed this month are of extreme difficulty and demand a 10-inch or larger, and perfect skies. (1950 positions.)

NGC 628, M74, $1^h\ 34^m.0$, $+15°\ 31'.6$. Faint spiral, Sc, 11.2 mag., 8′ x 8′; not usually listed in amateur books but visible. **NGC 16**, 154, $0^h\ 6^m.3$, $+27°\ 27'.2$; spiral, mag. 13.0, tiny and extremely difficult. **NGC 23**, 1473, $0^h\ 7^m.3$, $+25°\ 40'.5$. This is mag. 12.7, 1′ x 0′.6.

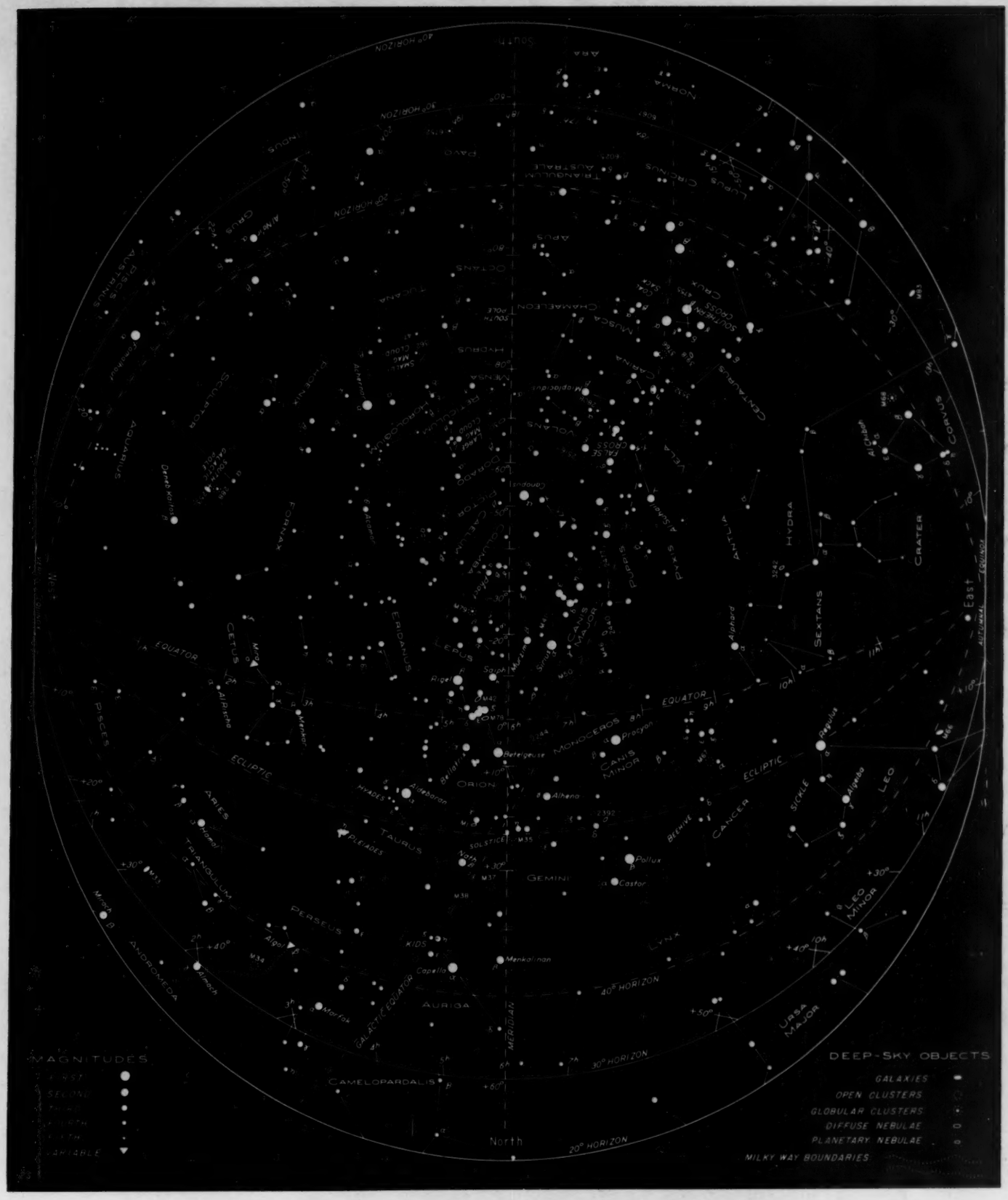
It may be wise here to remind readers that the spiral in Triangulum, M33, is so large, and so lacking in central condensation, that it is a difficult object in almost all telescopes. Use an ocular with a field of at least one degree.

WALTER SCOTT HOUSTON

STARS FOR NOVEMBER

from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of the month, respectively. The 40° north horizon is a solid circle; the others are circles, too, but dashed in part. When facing north, hold "North" at the bottom, and similarly for other directions. This is a stereographic projection, in which the flattened appearance of the sky itself is closely reproduced, without distortion.

Chart correction: Beta and Gamma Lyrae should be reversed.



EVENING STARS FOR SOUTHERN OBSERVERS

THIS CHART is prepared for a basic latitude of 30° south, but it may be used conveniently by observers 20 degrees on either side of that parallel. These southern charts appear in alternate months, but always two or three months in advance, to allow time for transmission to observers in any part of the world. The sky is here shown as it appears on Jan. 7th at 11 p.m., Jan. 23rd at 10 p.m., Feb. 7th and 23rd at 9 p.m. and 8 p.m., respectively. Times for other days vary similarly, four minutes earlier per day. These are local mean times which must be corrected for standard time differences. The 30° horizon is a solid circle; the other horizons are circles, too, those for 20° and 40° south being dashed in part. When facing south, hold "South" at the bottom, and similarly for other directions. Observers in the tropics may find north circumpolar stars on any of our northern star charts. For other charts in this series, see issues of alternate months from January, 1945, to July, 1946; October, 1946, to August, 1947; also September, 1947.